# 2014 FIJI FARM MANAGEMENT BUDGET MANUAL

- Technical: Part I
- Financial: Part II
- References: Appendix 1-12

## Table of Content — Page Numbers

# MESSAGE FROM THE MINISTER FOR AGRICULTURE

This Government is committed in alleviating poverty and improving the livelihood of the rural people of Fiji as stipulated in the Peoples Charter and the Strategic Framework for Change. Most of our rural people are living below poverty line and given the abundance of unutilized land resources in the rural Fiji, there is no reason why they should be cash poor. They are only poor because they are treating farming as just as a way of life rather than a business with clear goals and targets.

The production of the revised 2014 Farm Management Budget Manual is part of our commitment in making a difference to the livelihood of the people as it would be the tool used by Extension Officers and farmers in the formulation of Proposed Farm Business Plans and Better Farm Plans.

This is only possible through the tremendous work and effort of the Farm Management Section of the Land Resource Planning and Development Division. All Divisions within the Ministry were consulted and contributed towards the review of the Manual on all technical literature and financial implications of the document. This should be commended and I am proud to be associated with the production of the 2014 Farm Management Manual. The gross margin analysis shown could be used to develop whole farm budgets in order to determine the profitability level of different farming systems. This should be a core role of Extension officers in our quest to improve the livelihoods of farmers.

This Farm Management Budget Manual is the property of the Ministry of Agriculture and has the copyrights of the publication. The manual documents all the relevant information which could be used by farmers and planners in the formulation of Farm Business Plans. All the technical information were given and vetted by Research both in Crops and Livestock. Performance data and marketing data were also vetted by relevant divisions and some were related to actual farm data collated from farms all over Fiji. The manual is a changing document that will need to be reviewed every now and then when conditions change. When used properly, this document can assist farmers to improve efficiency and performance that is critical in our quest to increase Agriculture's contribution to the GDP.

In addition to that, the manual should be used by Extension Officers in the compilation of farmer's farm plans which is the core function of Extension Advisory Services. For the first time the manual includes as an appendix 'The Farming Systems Analysis and Development Approach' and the reporting formats that will need to be followed in order to make use of all information now detailed in the revised 2014 Farm Management Manual.

The reason for including the standardized reporting format is because of the different types of reports that has been observed to be used by different Extension Officers and some are not up to acceptable standard. The profitability of different farming systems is not clear and not well documented. It is the sincere desire of Management that this manual will be used productively by extension officers, planners, progressive farmers and students to determine profitability level and ensure improved efficiency in the Agricultural Sector.

The use of farming systems analysis data in determining government interventions or

projects for the farmers in the production and marketing phase makes this reporting a very critical one for the Ministry of Agriculture. We need to improve the quality of our service delivery and hopefully this will set the platform for the way forward.

We also have some legal obligations under the law in determining crop compensation rates and reviewing of land values under ALTA. This should run parallel with the updating of the financial part of this manual at all times.

I would like to appeal and call for your support in making use of the Manual to formulate good farm plans that can elevate the livelihood of rural farmers from subsistence to commercial level and contribute in making farmers to realize farming as a rewarding form of employment.

We are also reminded of the changing nature of the document that we should make it everybody's business to keep abreast with the impact of Climate Change, changes in prices of commodities and costs of inputs which will have a bearing on the bottom line of gross margins and profitability of different farming systems that exist in Fiji.

Vinaka Vakalevu and thank you very much.

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**Mr Inia Batikoto Seruiratu**
**Minister for Agriculture**

# FOREWORD BY THE PERMANENT SECRETARY

The production of the revised 2014 Fiji Farm Management Manual is a milestone achievement and a continuous tradition of the Ministry since its inception in 1978. It has certainly evolved and improved to meet the dynamic nature of the Agriculture sector and is now an improved version of the 1990 publication.

Historically the manual were in two separate publications that were combined in 1990. The 2014 version like the 1990 version has 3 major sections known as the technical section, financial section and related references which could be used by the farming community, agricultural field workers and planners in the formulation of Farm Business Plans and preparation of Project Proposals.

The manual attempts to put together basic information relating to agricultural resources, land, labor and capital and their best possible use. For the first time the manual includes as a chapter in Finance Section, the 'Record Keeping' guide to assist farmers to keep records in order to measure their performance and improve efficiency of farm production and profitability of farming business.

Unlike the 1990 version that was compiled in a folder to allow for regular updating, the 2014 version is in a book form and is now focused in helping our planners in carrying out the core role in our farm advisory services. The use of farming systems analysis in monitoring the impact of climate change is a matter of priority for the Ministry at this point to ensure sustainability.

Some additional reference materials have been included in this version including the Farming Systems Development Approach, Land-use Capability Classification, Systems and Processes that drive agricultural development in order to clarify the importance of farming systems analysis in the Ministry of Agriculture. I am indeed encouraged and wish to acknowledge all departments in the MOA who were consulted and contributed to the review of all technical literature and financial implications.

The gross margin analysis now available in the manual will be the basis of the whole farm or farming systems budgets that could be prepared with the use of this manual. With the changing nature of the farmers decision making environment the onus is now on all stakeholders to update their gross margins when changes arises.

I would like to encourage all those who contributed to the inputs for the technical and financial information to continue to do their updating and liase with the Farm Management Section in the updating of the Farm Management Information System that will be an ongoing activity in the future.

Vinaka Vakalevu and Thank you very much.

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**Ropate Ligairi**
**Permanent Secretary of Agriculture**

## ACKNOWLEDGEMENT

The Ministry of Agriculture is greatly indebted to those who have significantly rendered their contribution towards the compilation of the 2014 Fiji Farm Management Budget Manual.

- Director Research and the Team (MOA) - Chapters (or parts of) 1, 2 & 9
- Director Animal Health & Production (MOA) - Chapters (or parts of) 3, 4, 10
- Economic Planning & Statistics - Chapters (or parts of) 5
- Director Human Resource & Information - Layout and Logistics
- Director LRPD & Land Use Section - Appendix 2B
- Meteorological Office, Nadi - Appendix 1B
- Office of the Solicitors General - Appendix 6, 7, 8 & 9
- Senior Fisheries Officer - Central - Part of Chapter 10
- The Forestry Officer - Colo i Suva - Part of Chapter 1 & 9
- Fiji Development Bank - Chapter 8
- Fiji Sugar Cooperation - Part of Chapter 1 & 9
- FMIB - Part of Chapter 6 & 7
- Spices of Fiji, Wainadoi - Part of Chapter 1 & 9
- Commercial Firms
    i. Vinod Patel & Co. Ltd,
    ii. R.C. Manubhai & Co. Ltd,
    iii. Hop Tiy & Co. Ltd,
    iv. Kishore Investments Ltd - Levuka,
    v. South Pacific Fertilizers Limited,
    vi. Agchem Limited,
    vii. Levuka Service Station - Levuka,
    viii. Goodmanfielder International,
    ix. Pacific Feeds - Wailada.
    x. TOTAL - Fiji

    (Chapter (or parts of) 7, 9, 10.
- Mr. Earnest Douglas and Family of Waidau, Levuka.
- Popo Farm in Waituri.
- iTaukei Land Trust Board

All in all a special 'Vinaka Vakalevu' is extended to the Senior Management of the Ministry of Agriculture - FIJI for their organizational support which pave the way in the production of the 2014 Fiji Farm Management Budget Manual. Last but not the least a big Vinaka Vakalevu to Team Farm Management 2014 and their families and Jone Buatoka for the Artistic design that made the Manual unique from previous publications. Vinaka Vakalevu.

# INTRODUCTION OF THE FARM MANUAL

## FARMING AS A BUSINESS

The Ministry of Agriculture is now promoting farming as a business as opposed to farming as just a way of life. Agricultural commercialization implies that farms become sustainable commercial businesses where input uses; product choice and relative trade are market-oriented. Farming is not only concerned with increasing production and productivity, but has become involved with the distribution and marketing of produce. The concept of the farm as a business extends even further. Farmers are inevitably linked to finding solutions to marketing problems, and production decisions are influenced by the market. Farm produce must meet the needs of the consumer. This has brought about profound change in management vision and outlook. The desire to increase income by taking advantage of market opportunities requires farmers to become good decision makers and to be able to compete in this new environment. The emphasis on the market and the need of farmers to be competitive calls for improved farm management skills. Marketing and farm management have rapidly gained dominance.

## FARM MANAGEMENT

To run a business, the farmer must be a manager someone capable of taking initiatives, organizing production, marketing and assuming risks. Technical expertise is not enough. Farmers must know more about farm management, how to organize, manage and plan the farm in the best possible way. For farmers this involves a series of management decisions, relating to what to produce, how, and to whom to sell; how to compete in local and export market; how to finance and how much to invest in product differentiation; how to organize the productive farm enterprises and how to become part of a farmer's cooperative. It is the intention of the manual to provide the necessary information for planners to carry out that function.

The 2014 edition is an improvement of the 1990 version with the same 3 major sections including the technical information, Financial Information and Reference documents that would be needed in the preparation and formulation of farm plans and agricultural project proposals. Some emphasis have been put into showing the purpose of the manual in the farm planning and its relationship to the project cycle from the identification and preparation of agricultural projects with the inclusion of reporting formats of farming systems and related systems detailed in our reference document 3.

The reason for including the standardized reporting format is because of the different types of reports that had been observed to be used by different extension officers and some are not up to acceptable standard. The profitability of different farming systems is not clear and not well documented. It is the sincere desire of management that the manual will be used productively by extension officers, planners, progressive farmers and students to determine profitability level and ensure improved efficiency in the agricultural sector.

The first part of farm reporting which is universally acceptable is to do a property report followed by the management report and then the Better Farm Plan for an existing farmer appraisal or a Proposed Farm Plan for a new farmer. This is basically a resource inventory taking stock of available resources and clarifying features and the relevance of the resources to determine their limitations and potential. Are the resources used in the best manner or could it be used for something better. This format is consistent with FAO and international standard of Farm Reporting and is recommended for adoption in Fiji.

The use of farming systems analysis data in determining government interventions or projects for the farmers in the production and marketing phase makes this reporting a very critical one for the Ministry of Agriculture. We need to improve the quality of our service delivery and hopefully this will set the platform for the way forward.

The Farm Management Information System (FMIS) will provide regular revisions of the farm gate costs and prices and seasonal yield expectations which will be stored in a database. Each year the manual will be updated from the FMIS Database which should use average prices and costs ascertained from around the country through the Extension Services that will also be used to update the crop compensation rates in the future. Therefore the role of extension services in the updating of this manual would be very important for the future. The documentation of farming systems budget by the Farm Management Section in collaboration with crop and livestock Extension will be an ongoing activity that will make use of this manual and hence the need for ongoing updating.

In view of the dynamic nature of the farmer's decision making environment, the continous updating of farming systems data would be vital in order to capture the continous changing variables.

This 2014 manual is designed to clarify the Farming Systems Development Approach and its application for all Agriculture in Fiji to rise to the challenges in promoting farming as a business and as a rewarding form of employment.

**EDITORS:**
**TEAM FARM MANAGEMENT 2014**

# EXECUTIVE MANAGEMENT PICTORIAL 2014

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Director Land Resource Planning & Development Mr Nacanieli Waka (Front from left) with Team Farm Management 2014

CHAPTER 1

# 1.0 TECHNICAL INFORMATION ON CROPS


## INTRODUCTION

The chapter is the revised version of the Crop Calendar showing in detail, major crops grown in Fiji. It contains information on sowing rates of seed and planting materials on per hectare basis, recommended husbandry practices and details of planting and harvesting periods.

The information will support Extension Officers and planners in taking appropriate decision on crops and their sowing periods respecting the agro-ecological dimension. It also provides a solid base for planning in Farming Systems Development.

# Chapter 1.1 | Vegetables Grown in Fiji

# 1.1.1 Amaranthus
## *(Amaranthus viridis)*

**Recommended Varieties:**
Local Selection

**Seed Rate:**
4kg/ha

**Planting time:**
All year round

**Planting Site:**
Plant in an area that is close to a water source

**Spacing:**
Between rows: 50cm
Within rows: 15cm
Seeds can also be broadcasted into well made beds

**Germination:**
6 to 10 days after sowing.

**Fertilizer/Manure:**
Soil analysis should be done before fertilizer application.

*Poultry Manure:* 5 tonnes/ha. Mix well with soil before planting.

*Urea:* 50kg/ha. Two weeks after germination

**Weed Control/Management:**
Fusilade at 60ml/15L of water.
Point nozzle directly at the weed.
Spray at 3 to 4 leaf stage.

**Disease Control/Management:**
No major disease of economic importance, however in case of wilt-dig out affected plants and remove from field.

**Insect Control/Management:**
*Beet web worm:* Spray with Acephate 75% a.i at 20g/15L of water (Acephate is sold as Orthene & Sunthene)
*Leaf miners and Aphids:*
Spray *Phyrethroids* at 40ml/15L (Sold as *Attack*) or *Suncis* at 12ml/15L of water or Dimethioate at 15ml/15L of water (Sold as Rogor) or *Suncloprid* at 3.75 to 7.5ml/15L of water or *Bifenthrin* at 14 to 18ml/15L of water. Use protective clothing

*Caterpillar:*
Apply Steward at 7.5ml/15L or Superguard at 7.5ml/15L of water only when damage is visible.

**Harvest/Yield/Food Value:**
Follow the waiting period after spraying. Read label on containers.
Harvest when stems and leaves are tender. Weekly harvesting is recommended for larger areas.

**Yield:**
About 12 tonnes/ha.

Plant a new crop after the second harvest or plant in stages (phase planting).

**Food Value:**
Dietary fibre, Potassium, Calcium, Magnesium, Iron, Vitamin A, Vitamin B and Vitamin C

# 1.1.2 Bele
## *(Abelmoschus manihot)*

**Cropping Season:**
All year round

**Recommended Varieties:**
Local Selection
- White Local
- Red Local

**Seed Rate:**
13, 400 cuttings/ha

**Planting time:**
Can be grown all year round

**Planting material:**
Mature stems are cut to a length of 30cm and planted directly to prepared soil.

**Land Preparation:**
The field should be prepared very well as 2 ploughings and 2 harrowings are recommended.

**Spacing:**
*Between rows:* 100cm to 150cm
*Plants within rows:* 50cm

**Germination:**
Sprouts 1 to 2 weeks after planting. Site of planting: Bele should be planted at an area that is well drained and is close to water source.

**Fertilizer/Manure:**
*NPK:* 13:13:21
200kg/ha basal application.
*Urea:* 100kg/ha. In 4 split applications of 25kg/ha per every 3 months.

**Poultry Manure:**
5 tonnes/ha at land preparation 2 weeks before planting. Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
*Glyphosate* at 150ml to 200ml/15L of water (Sold as Round up, Champion 450, Rainbow & Rambo)

*Paraquat* at 100ml/15L of water (Sold as Gramazone, Agazone & Royal paraquat)

Read instructions on labels and spray carefully. Spray directly on weeds using a spray shield. Hand weed or hoe as necessary

**Disease Control/Management:**
Root and Collar Rot: Use disease free planting materials and make good drains. (Dip cutting in to Sundomil at 3.5g/L of water for 5 minutes before planting.

Do not plant soon after a crop of Pawpaw, okra or dalo.

**Insect Control/Management:**
*Spiny Ballworm:* Spray Acephate 75% a.i at 20g/15L of water (Acephate is sold as Sunthene)

Or Spray
*Phyrethroids* at 40ml/15L of water.
(Sold as *Attack*)

Or *Suncis* at 12ml/15L of water.

*Leaf Miners & Slugs:* Apply Carbaryl at 40g/15L of water) (Sold as Sevin)

Or *Malathion* at 30ml/15L of water and for Slugs use Metaldehyde Baits.

**Harvest/Yield/Food Value:**
Normally leaves become ready after 7 - 8 weeks.

Harvest at 2 to 3 weeks interval depending on individual preference.

**Food Value:**
Dietary fibre, Potassium, Calcium, Magnesium, Iron, Vitamin A, Vitamin C & Riboflavin

# 1.1.3 Capsicum
## *(Capsicum grossum)*

**Recommended Varieties:**
- Yolo Wonder A
- Yolo Wonder B
- Blue Star

**Seed Rate:**
300 grams/ha

**Planting Time:**
Cool season (April to Sept). Can be grown all year around under green house.

**Land Preparation:**
Field should be well prepared, 2 ploughing & 2 harrowing is recommended. Rotovate the soil if rotovator is available.

**Spacing:**
*Between rows:* 65cm - 75cm
*Plants within rows:* 30 - 40cm

**Germination:**
6 to 10 days after sowing.

**Transplanting**
Transplanting can be done during cloudy days or late in the afternoon.

Seedlings raised in seed trays can be planted any time of the day.

Water the plants after transplanting and continue afterwards.

**Fertilizer**
a) *PoultryManure:* 10 tonnes/ha Broadcast and mix well with 2 weeks before planting.

b) *NPK* - 13:13:21 200kg/ha basal application

c) *Urea:* 100kg/ha. Side dressed in 2 split applications i.e 2 -4 weeks after transplanting.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Practice inter-row cultivation, hoeing or hand weeding.
A small power tiller can be used for inter row cultivation.

**Disease Control/Management**
*Bacterial Wilt:* Use resistant varieties, Uproot affected plants & pack in bags, bury and burn. Practice crop rotation. of non host plants.

*Cucumber Mosaic Virus:* Destroy affected plants and control Mites & Aphids. Use clean planting materials.

*Soft Rot:* Avoid planting during wet weather. Remove all infected plants. Avoid damaging the crop during weeding. Use disease free seedling.

*Anthracnose:* Occurs when mature capsicum begins to ripe.

**Chemical Control:** Apply Benomyl at 16g/16L of water @ early flowering; apply Kocide @ rate of 16-21g/16L Water, Spray weekly before and after harvest; Apply Manzate 32g/16L water, Spray @ 2 weeks interval.

**Insect Control/ Management**
*Mites & Aphids:* Apply *Dimethioate* 16ml/16L of Water (Sold as *Rogor*), or *Suncloprid* at 4 to 8mls per 15L of water or *Bifenthrin* at 16-21ml/16L of water.

*Cutworms:* Spray Acephate 75% a.i at 12g/16l of water (Acephate is sold as *Orthene, Sunthene*) OR *Suncis* at 8ml/16L of water.

**Harvest Yield/Food Value:**
Fruits are ready for harvest at 3 months after planting and picking continues for 2-3 months.

**Yield:**
8 tonnes - 12 tonnes/ha

**Food Value:** A rich source of Vitamin A and Vitamin C.

# 1.1.4 Carrot
## *(Daucus carota)*

**Recommended Varieties**
- Chantenay
- Baby Carrot
- New Kuroda
- New Kuroda Improved

**Seed Rate:**
2.5kg - 4kg/ha

**Planting Time:**
Cool season (April to Sept) for better yield

**Land Preparation:**
Field should be well prepared, 2 ploughing & 2 harrowing is recommended. Rotovate the soil if rotovator is available.

**Spacing:**
*Between rows:* 50cm
*Plants within rows:* 8cm

**Germination:**
6 to 10 days after sowing.

Sow thinly in rows and thin out to correct spacing.

**Fertilizer:**
a) *Poultry Manure:* 10 tons/ha
Broadcast and mix well with soil before planting.

b) *NPK:* - 13:13:21 200kg/ha apply before sowing

c) *Urea:* 100kg/ha. Top dress when plants are about 3-5cm high, keep Urea away from the base of the plant.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Hand weeding and hilling as well as inter row cultivation.

**Disease Control/Management:**
*Alternaria Blight:* Make good drains. Dust seeds with Mancozeb/Thiram

*Soft Rot:* Apply Mancozeb at 53g/16L of water
Or
Kocide at 32g/16l of Water to prevent fungal infection.

*Root Knot Nematodes:* Avoid areas known to be infested with root knot nematode.
Rotate with non host crops, host crops are tomatoes, eggplant, okra, ginger & kava.

**Insect Control/ Management:**
Aphids: Apply Dimethioate 16ml/16L of Water (Sold as *Rogor*), or *Suncloprid* at 4 to 8/15L of water or *Bifenthrin* at 15-20ml/16L of water.

**Cutworms:** Spray *Acephate* 75% a.i at 12g/16L of water (*Acephate* is sold as *Orthene, Sunthene*)
OR
Suncis at 12.8ml/15L of water.

**Harvest Yield/Food Value:**
Harvest 15 - 18 weeks from planting.

Use harvesting forks to dig roots from the grounds and avoid pulling of plants.

**Yield:**
10 tonnes to 15 tonnes/ha.

**Food Value**
Dietary Fibre, Potassium, Vitamin A, Vitamin C & Vitamin K.

# 1.1.5 Cauliflower
## *(Brassica oleracea botritis)*

**Recommended Varieties:**

Local Selection

- Tropical Sureheart
- Snowqueen
- White Contessa
- Market Wonder
- Pioneer

Other varieties available
• Silver moon

**Seed Rate:**
300g/ha

**Planting time:**
April to August but performs best during cool and dry months. The flower will form only in cool season.

**Planting Method:**
Seeds are sown in well prepared seedbeds or seedling trays and transplanted in the field after 3 to 4 weeks or at 3 leaf stage

**Spacing:**
*Between rows:* 75cm
*Plants within rows:* 40cm

**Germination:**
3 to 5 days after sowing.

Transplant after 3-4 weeks.

**Fertilizer/Manure:**
*NPK:* 13:13:21
200kg/ha during planting.

*Urea:* 100kg/ha. Side dress 2 and 4 weeks after planting.

**Poultry Manure:**
5 tonnes/ha. Mix well in soil 2 weeks before planting.

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
Hand weeding and interrow cultivation.

**Disease Control/Management:**
*Crown Rot:* Spray Dithane M-45 at 22g/15L of water.

**Insect Control/Management:**
*Lepidopteran pest, Diamond Back moth, Large cabbage moth, Centre grub, Greasy cutworm:* Apply Superguard at 7.5ml/15L of water only when damage is visible.

Or Steward at 7.5ml/15L of water.

Practice Integrated Pest Management.

**Harvest/Yield/Food Value:**

**Yield:** 10 tonnes/ha

**Food Value:** Dietary fibre, Folate, Vitamin C, Thiamin, Iron and Zinc.

# 1.1.6 Chillies
## *(Capsicum annuum)*

**Recommended Varieties:**
- Red Fire
- Long Red Cayenne
- Bird's Eye
- Bongo Chilly

**Seed Rate:**
300 grams/ha

**Planting Time:**
Best to plant during hot weather season from September to February. Can be planted all year around.

**Planting Methods:**
Seeds are sown in well prepared seedbeds or seedling trays and transplanted in the field after 3-4 weeks or at 3 leaf stage

**Spacing:**
*Between rows:* 75cm
*Plants within rows:* 30cm

**Germination:**
5 to 10 days after sowing.

**Transplanting:**
Transplanting can be done during cloudy days or late in the afternoon. Seedlings raised in seed trays can be planted any time of the day. Water the plants after transplanting and continue afterwards.

**Fertilizer:**
*a)* *Poultry Manure:* 10 tonnes/ha Broadcast and mix well with soil 2 weeks before planting.
*b)* *NPK:* - 13:13:21 200kg/ha basal application
*c)* *Urea:* 100kg/ha. Side dressed in 2 split applications i.e 2 - 4 weeks after transplanting.

Soil analysis should be done during site selection.

**Weed Control Management:**
Practice inter-row cultivation using scarifier or small power tillers. Consult Locality Field Officer if you intend to export Chillies.

**Disease Control Management:**
*Stem Rot:* Apply *Sundomil* at 53g/15L of Water.

*Downy Mildew:* Apply *Dithane M-45* @ 23.4g/15L of Water.
*Anthracnose:* Spray:
- Benomyl at a rate of 16g/16L water @ early stage.
- Kocide @ a rate of 20-25g/16L Water @ weekly interval before and after harvest.
- Manzate @ a rate of 32g/16L Water.

Mites & Aphids: Apply *Dimethioate* 16ml/16L of Water (Sold as *Rogor*), or *Suncloprid* at 4 to 8/16L of water or *Bifenthrin* at 15ml -20ml/16L of water.

*Cutworms:* Spray *Acephate* 75% a.i at 12g/16L of water (*Acephate* is sold as *Orthene, Sunthene*) OR *Suncis* at 8ml/16L of water.

*White Fly:* Spray Acephate 75% a.i. at 12g/16L of Water.

BQA Requirements Red Fire & Hot Rod to be sourced from Sigatoka Research Station. Apply recommend practice for quality produce.

**Insect Control Management:**
*Mites & Aphids:* Apply *Dimethioate* 16ml/16L of Water (Sold as *Rogor*), or *Suncloprid* at 4 to 8/16L of water or *Bifenthrin* at 15ml -20ml/16L of water.

*Cutworms:* Spray *Acephate* 75% a.i at 12g/16L of water (*Acephate* is sold as *Orthene, Sunthene*) OR *Suncis* at 8ml/16l of water.

*White Fly:* Spray *Acephate* 75% a.i. at 12g/16L of Water.

BQA Requirements Red Fire & Hot Rod to be sourced from Sigatoka Research Station. Apply recommend practice for quality produce.

**Harvest Yield / Food Value:**
Fruits appear 90 - 120 days after planting and harvest weekly for one year.

**Yield:**
Fresh 16tonnes/ha
Dried 4-6 tonnes/ha

**Food Value:** Dried - Dietary Fibre, (Very High) Calcium; Vitamin A, Riboflavin and Niacin.

# 1.1.7 Chinese Cabbage *(Brassica chinensis)*

**Recommended Varieties:**
- Pak Choy
- Kwang Moon
- Wong Bok

**Seed Rate:**
300 grams/ha

**Planting Time:**
Best if planted during the cool season but can be grown throughout the year.

**Planting Methods:**
Seeds are sown in well prepared seedbeds or seedling trays and transplanted in the field after 3-4 weeks or at 3 leaf stage.

**Spacing:**
*Between rows:* 50cm - 75 cm
*Plants within rows:* 30 cm

**Germination:** 4 to 6 days after sowing.

**Transplanting:**
Transplanting can be done during cloudy days or late in the afternoon.

Seedlings raised in seed trays can be planted any time of the day.

Water the plants after transplanting and continue afterwards.

**Fertilizer:**
a) *Poultry Manure:* 5 tons/ha Broadcast and mix well with soil 2 weeks before planting.

b) *NPK:* - 13:13:21 200kg/ha broadcast and work into the soil before transplanting.

c) *Urea:* 100kg/ha. Side dressed in 2 split applications i.e 2 -4 weeks after transplanting.

Soil analysis should be done during site selection.

**Weed Control/ Management:**
Tzar at 19ml/15L of Water. Spray at 4-5 leaf stage of Weeds.

(Refer to label on the container on rates and application).

Practice manual weed control.

**Disease Control/Management:**
Soft Rot, White Rust: Practice good crop rotation.

Remove and destroy diseased plants by either burning or burying, as soon as symptoms appear and select only healthy planting material.

**Insect Control/ Management:**
*Lepidopteran pest, Diamond Backmoth, Large Cabbage Moth, Centre Grub, Greasy Cutworm:* Apply Superguard at 8ml/16L of Water or Steward @ 8ml/16L only when damage is visible.

*Aphids:* Dimethoate @ 16ml/16L *(Sold Rogor) or Suncloprid* @ 4ml - 8ml/16L of Water or *Bifenthrin* @ 15ml - 20ml/16L of Water.

**Harvest Yield/Food Value:**
Usually takes 30 - 60 days to get ready depending on variety.

**Yield:** Fresh 12tonnes/ha

**Food Value:** Source of Vitamin A, Vitamin B & Vitamin C.

# 1.1.8 Corriander
## *(Coriandrum sativum)*

**Recommended Varieties:**
- Small round seeded
- Large oblong seeded

**Seed Rate:**
10kg/ha

**Planting time:**
All year round but better in April to August

**Spacing:**
*Between rows:* 22.5 to 30cm
*Plants within rows:* 4-6cm
*Germination:* 6 to 10 days after sowing

**Fertilizer/Manure:**
*NPK:* 13:13:21 200kg/ha basal application at planting.

*Urea:* 100kg/ ha. Side dress 2 weeks after sowing.

*Poultry manure:* 5tonnes/ha Broadcast, mix well into the soil before planting. Soil analysis should be done before fertilizer application.

**Weed Control Management:**
Hand weed or hoe when necessary. Carry out inter-row cultivation.

**Disease Control Management:**
Susceptible to fungus disease especially in moist conditions. Maintain good drainage to prevent root rot.

**Insect Control Management:**
Generally it is pest free

**Harvest Yield Food Value:**
Regular harvest when the plants are 15-20cm about the ground.

**Yield:**
6 to 8 tonnes/ ha. Use in flavoring, curries and soup.

**Food Value:** (Leaves) Calories, Protein, Iron, Vitamin A, Thiamin, Riboflavin, Niacin, very high in Vitamin C, Potassium, Calcium, Magnesium. Nutritionally a good source but the quantities eaten are too small to be significant.

# 1.1.9 Cucumber
## *(Cucumis sativus)*

**Recommended Varieties:**
- Early Set
- Cascade
- Bountiful No. 2
- Space Master
- Early Perfection

**Seed Rate:**
2kg/ha

**Planting Time:**
All year around, fruits best during cool season.

**Planting Methods:**
Seeds are sown directly into well cultivated soil.

**Spacing:**
Between rows : 1m

**Plants within rows:** 30cm (trellising) - 50cm (ground creeping)

**Germination:** 5 to 7 days after sowing.

**Fertilizer:**
a) *Poultry Manure:* 5 tons/ha Broadcast and mix well with soil 2 weeks before planting.

b) *NPK:* - 13:13:21 200kg/ha basal application before sowing.

c) *Urea:* 100kg/ha. Side dressed in 2 split applications i.e 2 -4 weeks after transplanting.

- Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Hand weeding or hoeing is necessary. Weeds are removed when plants are still standing. Inter-row cultivation using horse drawn scarifiers can be used.

**Disease Control/Management:**
*Anthracnose:* Use healthy seeds of resistant varieties. Spray Manzate at 21g/16L of Water.

*Gummy Stem Blight, Mosaic Powdery Mildew:* Apply Benomyl @ 11g/16L of Water.

- Use Kocide at 32g/15L of Water to prevent fungal infections.
- Avoid planting at high density.

**Insect Control/ Management:**
*Aphids:* Dimethoate @ 16ml/16L (Sold *Rogor*) or *Suncloprid* @ 4ml - 8ml/15L of Water or *Bifenthrin* @ 15ml - 20ml/16L of Water or *Suncloprid* @ 8ml/16L of Water.

**Harvest Yield/Food Value:**
Harvest at 50 - 60 days after planting, continue picking of fruits for 3 weeks.

**Yield:**
Fresh 12 tonnes - 15 tons per hectare

**Food Value:**
Vitamin C

# 1.1.10 Duruka
## *(Saccharum edule)*

**Recommended Varieties:**
- Baribari
- Duruka Leka
- Wainikoro
- Thick White
- Pitpit Red

**Seed Rate:**
25, 641 setts/ha

**Planting Time:**
All year around

**Spacing:**
*Between rows:* 1.3m
*Plants within rows:* 30cm

**Germination:**
5 to 7 days after sowing.

**Fertilizer:**
a) Super Phosphate: 225kg/ha @ planting time.

b) Top Dress
With 60kg/ha of Potash at 8wks.

c) Urea 100kg/ha @ 10wks after planting.

Soil analysis should be done during site selection.

**Weed Control/ Management:**
Interow cultivation.
*Diuron 80* @ 120grams/15L of Water.

**Disease Control/Management:**
*Fiji Disease:* Spread by hoppers.

Uproot disease plants and burn them.
Use healthy planting materials & resistant variety. *Pitpit Red Variety* is tolerant to Fiji Disease.

**Insect Control/ Management:**
*Brown Hoppers:* Not significant when the population is low.

Spray Acephate 75% A.I at 12g/16L of Water (*Acephate* is sold as *Orthene & Sunthene*).

**Harvest Yield/Food Value:**
Harvest 8 - months in the following year's cropping season.

**Yield:**
1800 to 2560 bundles/ha

**Food Value:**
Protein, Dietary Fibre, Vitamin C, Potassium, Magnesium, Zinc, Iron.

# 1.1.11 Eggplant *(Solanum melongena)*

**Recommended Varieties:**
- Chahat
- Pritam/Long Purple.

**Seed Rate:**
300grams/ha

**Planting Time:**
All year around but best the hot and wet season.

**Spacing:**
*Between rows:* 1.5m
*Plants within rows:* 50 cm

**Germination:**
5 to 10 days after sowing.

**Transplanting:**
Seedlings should be transplanted when plants are 3 leaf stage. Seedlings raised in seed trays can be planted any time of the day

**Fertilizer:**
a) *Poultry Manure:* 10tonnes/ha. Broadcast and mix well with soil 2 weeks before planting.

b) *NPK:* 13:13:21 200kg/ha Basal application at planting

c) *Urea:* 100kg/ha. Side dress 2 & 4 weeks after planting.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Apply Paraquat @ 100mls/15L of Water.

Inter row cultivation.
Practice of hoeing in between the rows and within the plants.

Consult locality field officers if you plan to export eggplants.

**Disease Control/Management:**
Bacterial Wilt: Practice crop rotation with grain and avoid solanaceous crops (Tomatoes, Chillies, Bhindi, Capsicum & Potatoes), Uproot infected plants & burn.

**Damping off seedlings:** Plant on well drained soil. Treat seeds with Benomyl/Thiram.

**Blossom blight:**
Practice good field sanitation. Collect all mature fruits & disposed. Keep field area free on weeds.

Weed & avoid soil infested with Root Knot Nematode

Use *Kocide* @ 32g/16L of Water to prevent fungal infections.

**Insect Control/ Management:**
*Lygus Bug:* Apply Malathion 50 EC@ 45ml/16L of Water.

*Tobacco Flea Beetle:* Apply Malathion @ 45ml/16L of Water Or

Spray Acephate 75% (Sunthene) @ 12g/16L of Water.

*Thrips:* Apply Confidor at 8ml/16L of Water or Suncloprid @ 4-8ml/15L of Water or Bifenthrin @ 15-20mls/16ltr of Water.

*Arthregona:* Apply Dimethioate at 16ml/16L of Water (Sold as Rogor) or Malathion at 45ml/16L of Water.

**Harvest Yield/Food Value:**
Harvest 60-90 days after planting and continue for 6 months for Export market.

For the local market, harvesting can continue for over a year.

**Yield:** 20-25tonnes/ha.

**Food Value**
Dietary Fibre, Vitamin C.

# 1.1.12 English Cabbage
## *(Brassica oleracea)*

**Recommended Varieties:**
- FS Cross
- KK Cross
- KY Cross

**Seed Rate:**
300grams/ha

**Planting Time:**
Best if planted during the cool season but can be grown all year around.

**Spacing:**
Between rows: 75cm
Plants within rows: 45-60 cm
Germination : 4 to 6 days after sowing.
Transplant 3-4 weeks after sowing.

Transplanting can be done during cloudy days or late in the afternoon.
Water the plants after transplanting and continue afterwards. Seedlings raised in seed trays can be planted any time of the day

**Fertilizer**
*Poultry Manure:* 5 tonnes/ha Broadcast and mix well with soil 2 weeks before planting.

*NPK:* - 13:13:21 200kg/ha basal application at planting.

*Urea:* 100kg/ha. Side dressed in 2 split applications i.e 2 - 4 weeks after transplanting.

- Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Apply Tzar @ 19ml/15L of Water. Spray at 4-5 leaf stages of grass weeds. Manual hand pulling of weeds and use hoe for small areas.

Inter row cultivation using scarifier or small rotovator.

**Disease Control/Management:**
Leaf Spot: Brown or black spots on the leaves. Under favorable conditions spots merge causing leaf to dry & burnt.
- Remove, burn and bury diseased plants.
- Remove all remains of last crop.
- Practice crop rotation of non host plants.
- Buy seeds from reliable outlets.

**Insect Control/ Management:**
Lepitopteran Pest, Diamond Backmoth, Large Cabbage Moth, Center Grub, Greasy Cutworm : Apply Superguard @ 8ml/16L of Water Or Steward @ 8ml/16L of Water only when recent damage is visible. or Ag Chem BT at 8g/16L of Water.

**Harvest Yield/Food Value:**
Harvest @ 60-90 days after planting.

**Yield:**
15-20 tonnes/ha.

**Food Value:** Good source of Vitamin A, Vitamin B and Vitamin C.

# 1.1.13 French Bean
## *(Phaseolus vulgaris)*

**Recommended Varieties**
- Contender
- Butter Bean
- Labrador

**Seed Rate**
45kg - 50kg/ha

**Planting Time**

Best yields from April to September.

**Spacing**
Between rows: 50cm
Plants within rows: 15cm - 20 cm
Germination: 3 to 6 days after sowing.

**Fertilizer**
a) Poultry Manure: 10tonnes/ha. Broadcast and mix well with soil 2 weeks before planting.

b) NPK: 13:13:21 200kg/ha Basal application at planting

c) Urea: 100kg/ha. Top dress 2 & 4 weeks after planting.

Soil analysis should be done during site selection.

**Weed Control/ Management**
Apply Tzar @ 19ml/15L of Water. Spray at 4-5 leaf stages of grass weeds.

Practice of hoeing in between the rows and within the plants when necessary.

Inter row cultivation.

**Disease Control/Management**
Powdery Mildew: Apply Benomyl @ 11g/16L of Water.
Plough plant remnants after harvest & rotate with Mildew resistant vegetable like Tomato, Cabbage & Eggplant.

Rust, Root Stem Rot, Angular Spot: Apply Benomyl @ 11g/16L of Water
OR
Mancozeb @ 32g/15L water
Or
Kocide 32g/16L water to prevent fungal infections.

**Insect Control/ Management**
Lepitopteran Pest, Diamond Backmoth, Large Cabbage Moth, Center Grub, Greasy Cutworm : Apply Superguard @ 8ml/16L of Water

OR

Steward @ 8ml/16L of Water only when recent damage is visible.

OR

Ag Chem BT at 8g/16L of Water.

**Harvest Yield/Food Value**
Harvest tender pods 40-60 days after planting.

Picking continues for 4-6 weeks.

**Yield:** 7 -10 tonnes/ha.

**Food Value**
Dietary Fibre, Vitamin C.

# 1.1.14 Lettuce
## *(Lactusa sativa)*

**Recommended Varieties:**
*Head Type:*
- Great Lakes
- Boxhill

*Leafy Type:*
- Green Mignonette
- Butter crunch
- Coral Lettuce
- Rapid

**Seed Rate:**
300grams/ha

**Planting Time:**
*Head Type:*
March to October

*Leafy type:*
All year round.

**Spacing:**
*Between rows:* 75cm
*Plants within rows:* 30-40 cm
*Germination:* 5 to 8 days after sowing.

Raised the seedlings in seed trays/seed bed and transplant at 3 to 4 leaf stage.

Seedlings raised in seed trays can be planted any time of the day

**Fertilizer:**
a) *Poultry Manure:* 5 tonnes/ha. Broadcast and mix well with soil 2 weeks before planting.

b) *NPK:* 13:13:21 200kg/ha Basal application at planting

c) *Urea:* 100kg/ha. Top dress 2 & 4 weeks after planting.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Manual weed control using hoe.

Inter row cultivation.

**Disease Control/Management:**
*Soft Rot:* Practice crop rotation Benomyl @11g/16L water. Avoid planting with high density.

*Downey Mildew:*
Light green to yellow spots on the upper leaf, Later turns brown, soft and limy.

- *Practice crop rotation.*
- Remove all left over crops after harvesting. Use Sundomil @ 53g/16L of water.

Use Kocide @ 32g/16L Water to prevent fungal infections.

**Insect Control/ Management:**
*Thrips:* Apply Confidor @8mls/16L water
Or
*Suncloprid* @ 4-8ml/15L water or *Bifenthrin* @ 14-18mls/15L of Water.

*Cutworms Caterpillar:*
Apply Malathion @ 45ml/16L of Water.

*Slugs:* Keep surrounding clean, spread around Blitzem pellet as per instructions on the label.

**Insect Control/ Management**
*Thrips:* Apply Confidor @8ml/16L water
Or
*Suncloprid* @ 4-8ml/15L water or *Bifenthrin* @ 14-18ml/15L of Water.

*Cutworms Caterpillar:*
Apply Malathion @ 45ml/16L of Water.

*Slugs:* Keep surrounding clean, spread around Blitzem pellet as per instructions on the label.

**Harvest Yield/Food Value:**
Leafy Lettuce matures in 50-80 days.

Head Type matures in 12-15weeks.

**Yield:** 8 -10 tonnes/ha.

**Food Value:**
Dietary Fibre, Source of Vitamin A, Vitamin B and C

# 1.1.15 Long Bean
## *(Vigna sesquipedalis)*

**Recommended Varieties:**
- Local White
- Yard Long (Dark Green)

**Seed Rate:**
7kg/ha

**Planting Time:**
All year around. Performs best during hot and wet season.

**Spacing:**
For trellising
*Between rows:* 65cm - 75cm
*Plants within rows:* 15cm-20 cm
*Germination:* 3 to 6 days after sowing.

**Fertilizer:**
a) *Poultry Manure:* 10 tonnes/ha. Broadcast and mix well with soil 2 weeks before planting.

b) *NPK:* 13:13:21 200kg/ha Basal application at planting

c) *Urea:* 100kg/ha. Top dress 2 & 4 weeks after planting.

Soil analysis should be done during site selection.

**Weed Control/ Management:**
Tzar at 20mls/15L of water
(post emergence weedicide). Spray when grass weeds are at 4-5 leaf stages.

Hand weed or hoe when necessary. as well as Inter - row cultivation with the use of scarifier or rotor tillers.

**Disease Control/Management:**
*Rust:* Apply Benomyl at 11g/16L Water
Or
*Kocide* at 32g/16L of Water.

Plough plant remnants thoroughly after harvesting, rotate with Vegetables like Cabbage, Eggplant and Tomatoes.

*Root and Stem Rot:*
Use Kocide @32g/16L Water.

**Insect Control/ Management:**
Bean Pod Borer: Spray Lannate @ 32ml/16L Water or Sundothrin @ 17ml - 22ml/16L of Water.

*Aphids:* Apply Dimethioate @ 16ml/16L of Water

Observe the waiting period.

**Harvest Yield/Food Value:**
Harvest at 50-60 days from planting, pick pods when still tender and harvesting continues for about 2-3 weeks.

*Yield:* 7-10 tonnes /ha.

**Food Value:**
Dietary Fibre, Vitamin C, Niacin, Vitamin B Complex, Iron and Zinc.

# 1.1.16 Okra
## *(Abelmoschus esculentus)*

**Recommended Varieties:**
- Clemson Spineless
- Local Long White
- Dwarf long Pod

**Seed Rate:**
8kg/ha

**Planting Time:**
All year around but better during hot months.

**Spacing:**
*Between rows:* 75cm - 1m
*Plants within rows:* 20cm-30 cm
*Germination:* 3 to 6 days after sowing.

**Fertilizer:**
*a)* *Poultry Manure:* 10 tonnes/ha. Broadcast and mix well with soil 2 weeks before planting.

*b)* *NPK:* 13:13:21 200kg/ha Basal application at planting

*c)* *Urea:* 100kg/ha. Side dress 50kg/ha @2weeks and 50kg/ha @ 4 weeks after planting.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Hand weed or hoe when necessary and practice inter row cultivation using animal drawn scarifier.

**Disease Control/Management:**
Powdery Mildew: Apply Benimyl at 11g/16L water.

Rotate with crops of different family such as Fabaceae, Solanaceae but not Malavaceae.

Use Kocide at 32g/16L of water to prevent fungal infections.
Okra Galls is associated with climatic conditions and affects the fruits of older plants. To avoid this problem plant Clemson Spineless from Oct to March or plant with other vegetables of different families.

**Insect Control/ Management:**
*Spiny Bollworm, Corn Ear Worm & Leaf Miners.* Spray *Sunthene* @ 21g/16L Water.

*Aphids:* Apply Rogor @ 16ml/16L Water or Suncloprid @ 8ml/15L Water.

*Snails and Slugs:*
- Use Blitzem pellets.
- Burn crop residues.

Crop Rotation can also help reduce pest and disease attack.

**HarvestYield/Food Value:**
Harvesting of tender pods at 60-90 days from planting; and is carried out 2 to 3 times a week and continue for 1 year.

**Yield:** 15 tonnes

**Food Value:**
Dietary Fibre, Potassium, Calcium, Magnesium, Vitamin C.

# 1.1.17 Pumpkin
## *(Cucurbita maxima)*

**Recommended Varieties:**
- Queensland Blue
- Butternut
- Local Selection

**Seed Rate:**
1.5kg/ha

**Planting Time:**
All year around

**Spacing:**
*Between rows:* 1.5m
*Plants within rows:* 1m

**Germination:**
3 to 6 days after sowing.

**Fertilizer:**
a) Poultry Manure: 10 tonnes/ha. Broadcast and mix well with soil 2 weeks before planting.

b) NPK: 13:13:21 200kg/ha Basal application at planting

c) Urea: 100kg/ha. Side dress 3-4 weeks after planting.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Hand weed or hoe when necessary but do not damage the stem.

Inter row cultivation is also recommended

**Disease Control/Management:**
Powdery Mildew: Apply Benomyl at 11g/16L water.

Rotate with crops of different family such as Maize, and Eggplants.

Use *Kocide* at 32g/16L of water to prevent fungal infections.

**Insect Control/ Management:**
*Pumpkin beetle:* Apply Sunthene @ 12g/16L Water.

Crop Rotation can also help reduce pest and disease attack.

**Harvest Yield/Food Value:**
Harvest at 12-15 weeks from planting.

**Yield:**
10-15 tonnes

**Food Value:**
Dietary Fibre, Potassium, , Vitamin C & Vitamin A.

# 1.1.18 Radish
## *(Raphanus sativus)*

**Recommended Varieties:**
- Long Whiteside
- Awa Cross
- Everest

**Seed Rate:**
10 kg/ha

**Planting Time:**
Can be planted all year round

**Spacing:**
*Between rows:* 50cm
*Plants within rows:* 5cm

Broadcast then thin out to 5cm apart 2-3 weeks after germination.

**Fertilizer:**
*Poultry Manure:* 5 tonnes/ha. Broadcast and mix well with soil before planting.

b) *NPK:* 13:13:21 200kg/ha Basal application at planting

c) *Urea:* 100kg/ha. Side dress 3-4weeks after planting.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Pull out weeds or use a hoe.

**Disease Control/Management:**
No serious disease.

**Insect Control/ Management:**
No serious pests

**Harvest Yield/Food Value:**
Harvest at 30 days- 40 days from planting.

**Yield:**
8-15 tonnes/ha

**Food Value:**
Dietary Fibre & Vitamin C.

# 1.1.19 Spring Onion
## *(Allium cepa)*

**Recommended Varieties:**
- White Lisbon
- Yellow Bermuda

**Seed Rate:**
4kg/ha

**Planting Time:**
At the start of the cool season.

**Spacing:**
Between rows: 50cm
Plants within rows: 8cm

**Germination:**
6 to 10 days after sowing.

**Fertilizer/Manure:**
*NPK:* 13:13:21 200kg/ha basal at planting.
*Urea:* 100kg/ha Side dress 4-6 weeks after planting.

**Poultry Manure:**
5 tonnes/ha

Mix well in the soil 2 weeks before planting.

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
Mulch with straw materials.

Hand weed or hoe when necessary; spray pre emergence herbicide.

**Disease Control/Management:**
*Powdery Mildew:* Mancozeb at 50g/15L water or Apply Benomyl at 10g/15L of water. (Sold as Benlate)

Use Kocide at 30g/15L of water to prevent fungal infections.

**Insect Control/Management:**
Damage caused is negligible.

**Harvest/Yield/Food Value:**
8 to 12 weeks after planting

**Yield:**
10 to 12 tonnes/ha

**Food Value:**
Source of Iron, Zinc, Vitamin C and Thiamin.

# 1.1.20 Tomato
## *(Lycopersicon esculentum)*

**Recommended Varieties:**
- Alton
- Redland

**Summer taste**
- Alafua Large

**Cropping Season:**
May to October

**Seed Rate:**
300 grams/ha

**Planting Time:**
Main season in the cool months (May to October) Off season from November to April.

**Spacing:**
*Between rows:*
0.75m to 1.0m Plants within rows 30 to 40cm for staked varieties.

*Between rows:*
1.5m

*Plants within rows:*
30cm For indeterminate varieties grown in open fields.

**Fertilizer Manure:**
*NPK:* 13:13:21 200kg/ha basal at planting.

*Urea:* 100kg/ha Side dress 2 & 4 weeks after planting.

*Poultry Manure:* 12 tonnes/ha Broadcast 2 -3 weeks after planting. Soil analysis should be done before fertilizer application.

**Weed Control Management:**
Hand weed or hoe for small plots. Inter row cultivation when plants are still small. Practice mulching to control weeds and retain soil moisture.

**Disease Cotrol Management:**
*Anthracnose:* Apply *Mancozeb* at 50g/15L of water. Bacterial Wilt Avoid planting where solanaceous plants were previously planted. Dig, remove and destroy infected plant. Improve drainage. Use a two-year rotation and use resistant varieties. Stem *Rot:* Use a two-year rotation.

*Leaf mould Mosaic/ Blossom end Root Rot:* Have your soil tested for corrective measures. Use *Kocide* (30g/15L of water) to prevent fungal infections.

**Insect Control Management:**
*Spider (Tomato) Mite:* Apply Malathion at the rate of 30ml/15L of water. Practice proper field sanitation.

*Fruit worm or Fruit Borer:* Steward at 7.5ml/15L of water. Or Delfin at 14g/15L of water.

*Green semi looper:* Endosulfan at 10ml/15L of water or Suncis at 12ml/15L of water.

**Harvest Yield Food Value:**
10 to 12 weeks after transplanting and picking continues for 5 weeks.

**Yield:** 10 to 15 tonnes

**Food Value:** Source of Potassium, Calcium, Sodium, Dietary fibre and Protein.

# 1.1.21 Watercress
## *(Rorripa nasturium aquaticum)*

**Cropping Season:**
February to July

**Seed Rate:**
66,666 cuttings

**Planting Time:**
October to April

**Spacing:**
*Between rows:* 50cm
*Plants within rows:* 30cm
*Germination:* 2 weeks after planting.

**Fertilizer Manure:**
*Urea:* Side dress at two weeks after sprouting.

*Poultry Manure:* Mix well in the soil before planting.

Soil analysis should be done before fertilizer application.

**Weed Control Management:**
Remove water weeds by hand.

**Disease Control Management:**
No major disease of economic importance.

**Insect Control Management:**
No major pest of economic importance
**Harvest/Yield/Food Value:**
5 to 6 weeks after planting

**Yield:** 5 to 8 tonnes

**Food Value:** Dietary fibre, Potassium, Calcium, Iron, Vitamin A and Vitamin C (very high)

# 1.1.22 Zucchini *(Cucurbita pepo)*

**Cropping Season:**
Cool dry but can be grown all year round

**Recommended Varieties:**
- Marrow
- Black Jack

**Seed Rate:**
3kg/ha

**Planting Time:**
Cool season

**Spacing:**
Between rows: 1m
Plants within rows: 30cm

**Germination:** 5 to 10 days after sowing.

**Fertilizer/Manure:**
*NPK:* 13:13:21 200kg/ha Basal at planting.

*Urea:* 100kg/ha Side dress 3 to 4 weeks after germination.

**Poultry Manure:**
12 tonnes/ha Broadcast, mix well before planting.

Soil analysis should be done before fertilizer application.

**Weed Control/Management**:
Hand weed or hoe when necessary.

Practice mulching to control weeds and retain soil moisture.

**Disease Control/Management Powdery Mildew:**
Apply Benomyl at 10g/15L of water (Sold as Benlate) or Copper Oxychloride at 60g/15L of water (Sold as KOPI)

*Downey Mildew:* Apply Antracol at 30g/15L water or Mancozeb at 50g/15L water. Use Kocide at 30g/15L of water to prevent fungal infections.

**Insect Control/Management:**
*Squash Bug and 28 Spotted Lady Bird beetle:* Spray *Malathion* at 30ml/15L water or *Suncloprid* at 3.75 to 7.5ml/15L of water or *Bifenthrin* at 14 to 18ml/15L of water.

or *Spray Acephate* 75% a.i at 20g/15L of water (Acephate is sold as *Orthene & Sunthene*)

*Aphids:* Dimethioate at 15ml/15L of water (Sold as Rogor) or Suncloprid at 3.75 to 7.5ml/15L of water or Bifenthrin at 14 to 18ml/15L of water.

*Squash Bug:* Spray Acephate 75% a.i at 20g/15L of water (Acephate is sold as Orthene & Sunthene)

**Harvest/Yield/Food Value:**
6 to 8 weeks after planting

**Yield:**
8 to 10 tonnes/ha

**Food Value:**
Dietary fibre, and Vitamin C.

# Chapter 1.2 | Root Crops Grown in Fiji

# 1.2.1 Cassava
## *(Manihot esculenta)*

**Recommended Varieties**
- Beqa
- Yabia Damu
- New Guinea
- Sokobale
- Nadelei
- Vulatolu

**Seed Rate**
*Mechanised:* 20,000 cuttings/ha.

*Traditional:* 20,000-30,000 cuttings per ha.

**Spacing**
*Mechanized:* Ridges - 1m between rows

Plants within rows 50cm

Cutting 30cm in length.

*Mounds:* 0.5m in diameter.

Traditional - 1m x 1m

**Fertilizer**
*NPK* - 13:13:21.

Poor soil; 200kg;ha @ planting.

*Rich Soils* - NPK 13:13:21 100kg/ha at planting.

*Urea:* 100kg/ha at split application 50% at planting & 50% after 4 weeks.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management**
Paraquat @ 100ml/15L Water.

Hand Weeding is also recommended.

**Disease Control/Management**
*Leaf Spot:* Not an economic disease.
- No need to control.

**Insect Control/ Management**
*Red Spider Mite:* Spray Dimethiote @ 16ml/16L of Water. (Sold as Rogor).

*Black Scale & White Peach:* Spray with Suncis @ 8ml/16L of Water.

Spiraling White Fly
Spray Diazinon @ 64ml/16L of Water.

Use biological control agent Nephasis bio-active in field.

**Harvest Yield/Food Value**
*Early Varieties:* Mature in 8-10 months.

*Late Varieties:* Mature in 12 months.

**Yield**
20-30 tonnes/ha

**Food Value**
Source of Vitamin A & Vitamin C.

# 1.2.2 Dalo
## *(Colocasia esculenta)*

**Recommended Varieties:**
- Samoa hybrid
- Samoa
- Tausala ni Samoa
- Vula Ono
- Maleka Dina
- Dalo ni Toga
- Kuro Kece
- Wararasa
- Toakula
- Vavai

**Seed Rate:**
*Traditional Farming System:* 10,000 suckers/ha
*Mechanize System:* 16660 suckers/ha

**Planting Time:**
July to January
*Off Season:* March to June
*Wet Zone:* Through out the year
*Intermediate Zone:* Sept to March

**Spacing:**
Traditional System:
*Between rows:* 1m
*Plants within rows:* 1m

Mechanize Systems:
*Between rows:* 1m
*Plants within rows:* 60cm

**Fertilizer:**
*Poultry Manure:* 10 tonnes/ha. Broadcast and mix well with soil before planting.

b) *NPK:* 13:13:21 200kg/ha Basal application at planting and after 15 weeks from planting

c) *Superphosphate:* 25kg/ha & Muriate of Potash 100kg/ha at planting (can be used if NPK is unavailable)

c) *Urea:* 100kg/ha. Apply in 2 split application 15g/plant at 5, 10 wks after planting.

**Weed Control/ Management:**
Paraquat @ 100ml/15L Water. Hand Weeding

**Disease Control/Management:**
*Corm Rot:* Improve drainage & Have soil test for Nutrient status.

*Shot Hole Spot:* A seasonal disease; which disappears when the weather changes. Remove infected leaves & burn.

*Good husbandry:* - regular weeding and timely fertilizer application minimize loss.

**Insect Control/ Management:**
*Plant Hoppers, Cutworms, White Fly Cluster, Caterpillar:* Spray Diazinon @ 64ml/16L Water
Or
*Sunthene* 21g/16L Water.

*Taro Beetle:* Apply *Confidor* at 26ml/16L Water
Or
*Suncloprid* @ 4-8ml/16L Water
Or
*Bifenthrin* @ 15-20ml/16L Water.

**Harvest Yield/Food Value:**
Harvesting @ 6-7 months for Hybrid Varieties whilst traditional varieties are ready at 9 months for harvest.

**Yield:** 20-25 tonnes/ha

**Food Value:** Contains large amount of Vitamin A, Vitamin B1, Vitamin B2 and Vitamin C.

# 1.2.3 Dalo ni Tana
## *(Xanthosoma saggitifolium)*

**Cropping Season:**
All year around

**Recommended Varieties:**
- Vula
- Dravuloa

**Seed Rate:**
10,000 plants per hectare.

**Planting Time:**
January to December.

**Spacing:**
Between rows: 1m
Plants within rows: 1m
Planting depth: 30 cm

**Fertilizer/Manure:**
*N:P:K:* 13:13:21 200kg/ha - Basal application

*Urea:* 100kg/ha 50% at 5 weeks

**Poultry Manure:**
10 tonnes/ha

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
Paraquat at 100ml/15L of water (Sold as Gramazone, Agazone & Royal paraquat)

- Hand Weed.

**Disease Control/Management:**
No major disease of economic importance.

**Insect Control/Management:**
Plant Hoppers and Cutworms:
Apply Malathion at 30ml/15L of water
Or Diazinon at 60ml/15L of water when appropriate.

**Harvest/Yield/Food Value:**
Harvest 12 months after planting

**Yield:** 15-20 tonnes/ha.

**Food Value:**
Source of Vitamin B, Vitamin C, Starch and Protein.

# 1.2.4 Ginger
## *(Zingiber officinale)*

**Recommended Varieties:**
- White Ginger
- Red Ginger

**Seed Rate:**
*Immature:* 7500kg
*Mature:* 5000kg
*Planting Time:* September

**Spacing:**
Slope Land
*Immature:* 60cm between rows & 15cm within rows.
*Mature:* 60cm between rows & 20cm within rows.

Flatland:
*Immature:* 90cm between rows, 15cm within rows.
*Mature:* 90cm between rows & 20cm within rows.

**Fertilizer:** Poultry Manure: 10 tonnes/ha. Broadcast and mix well with soil 4 weeks before planting.

*b)* *NPK:* 13:13:21 1000kg/ha - 2 split application, 500kg/ha Basal application at planting & 3 months after planting.

*c)* *Urea:* 300kg/ha. Top dress in 3 split applications i) 100kg/ha - 1st application @ 2-3 leaf stage ii) 2nd application @ 8 wks after first application iii) 3rd application @ 4 weeks after second application.

Hilling to be carried out after each application.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Atrazine 4L/ha.
(Pre emergence weedicide) Spray after planting @ the rate of 60ml/15L of Water.

**Disease Control/Management:**
*Phythium Rot:* Treat planting material in *Sundomil* 3.5g/L of Water in 5 minutes.

Remove infected plants and burn.

*Bacteria Rot (Erwnia):* Remove infected plants and ensure good drainage system.

**Insect Control/ Management:** *Root knot Nematodes:* Hot water treatment of Planting materials at 51° C for 10 minutes.
- Crop rotation with Cassava & Dalo.
- Sanitation - Remove all rhizomes from the field after harvesting.
- Proper selection of seed materials.

*Tuber Scale Insect:* Dip rhizome in Diazinon @ 64ml/16L of Water before planting.

**Harvest Yield/Food Value:**
*Immature:* Harvest at 5 months from planting (Fibre content = 30-40%)

*Mature:* 10 months from planting.

**Yield:**
*Immature:* 20-25tonnes/ha
*Mature:* 25-30tonnes/ha.

**Food Value:**
Good source of Energy, Potassium, Calcium & Sodium.

# 1.2.5 Kawai
## *(Dioscorea esculenta)*

**Cropping Season:**
July to September

**Recommended Varieties:**
- Kawai tabua
- Kawai cagocago
- Tabo dina
- Sarau dra
- Kawai cikobia

**Seed Rate:**
10,000 mounds/ha.
***Traditional:*** 4 tonnes/ha
***Mechanized:*** 16,700 sett/ha

**Spacing:**
***Traditional:***
*Between rows:* 1m
*Plants within rows:* 1m

***Mechanized:***
*Between rows:* 1m
*Plants within rows:* 0.6m

**Fertilizer/Manure:**
*N:P:K:* 13:13:21
- 200kg/ha at planting time.

*Urea:* 100kg/ha at 8 weeks
- 100kg/ha at 12 weeks.

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
Pre emergence Altrazine at 120ml/15L of water.

Paraquat at 100ml/15L of water (Sold as Gramazone, Agazone & Royal paraquat)
- Use spray shield, avoid touching crop plants.

**Disease Control/Management:**
*Dioscorea Leaf Spot:*

If need be spray with Benomyl at 10g/15L of water. (Sold as Benlate)

**Insect Control/Management:**
No major insect problem.

**Harvest/Yield/Food Value:**
**Yield:** 8-10 tonnes/ha

**Food Value:**
Source of Vitamin E, Vitamin C, Thiamin and Riboflavin.

# 1.2.6 Kumala
## *(Ipomoea batatas)*

**Recommended Varieties:**
- Honiara
- Talei
- Vulatolu
- Kabara
- Bua
- Local Purple
- Korolevu Red
- Papua
- Carrot

**Expected Yield:**
15 -20 tonnes/ha

**Planting Time:**
April/May

**Plant Density/ Spacing:**

**Traditional:**
Between rows - 80cm
Within rows - 50cm

**Mechanized:**
Between rows - 1mtr
Plant Within rows - 30cm

**Length of Vine** - 40cm

**Soil Requirement:**
Kamala grows best on looses, fertile soil with good drainage.

**Fertilizer Requirements:**
*NPK* (80: 40: 100) = 80 kg Urea/ha 40kg P2 05/ha + 100kg k20/ha at 30 days after planting.

**Plant protection:**
***Weed control:***
- Hand weed.

**Insect pest:**
- sweet potato weevil.

***Control by: -***
Crop rotation – rotate Kumala with other crops.

Hill up to cover tubers.

Use clean planting materials

Harvest damaged plants as soon as possible.

**Time to Maturity:**
4 - 5 months.

**Harvesting & Storage:**
Store in Dry Place.

**Food Value:**
Source of Carbohydrates

**Leaves:**
Source of Iron and Proteins

# 1.2.7 Potato
## *(Solanum tuberosum)*

**Recommended Varieties:**
- Domoni
- Red Pontiac
- Dalisay
- Servance
- Sebago
- Sequioa

**Expected Yield:**
12- 15 tonnes /hectare

**Planting Density:**
Furrows 5.0 – 7.5 cm depth * 0.7 m between rows * 0.3 m within rows.

Up to 47,000 plants per Hectare

**Soil Requirements:**
Prefers well structured, Friable sandy loam soil.

Also grown on heavier soils.

**Fertiliser Requirements:**
12t/ha *Poultry Manure:*
*- Rice Straw*

*NPK:* ( 13: 13: 21) 200 kg/ha
Urea 100kg/ha

*Note:* Poultry manure added into the soil 1 week before planting. NPK applied as basal dressing. Urea applied as side dressing about 4-6 weeks after planting.

**Plant protection:**
(a) *Weed control:* hand weeding or inter-row cultivation spraying paraquat can also be used for inter –row spaces.

*Note:* Crop should be kept weed free in the first 4 weeks to obtain optimal yield

(b) *Irrigation:*

Potatoes are highly sensitive to water stress. Irrigation with good quality water is necessary once a week during dry seasons.
Excessive irrigation can lead to diseases and rotting tubers.

Mulching with rice straw, Sugar – cane leaves or grass lowers soil temperature and reduces evaporation.

(c) *Insect Pests:*
i) Aphids, Cutworms, slugs and thrips

Use: Ambush 5g per 14L water dibron 90% E.C 14ml per 14L of water.

ii) *Nematodes*
Control through crop rotation and soil fumigation

c) *Disease*
i) Bacterial Wilts
Use resistance varieties

ii) Early and late Blight.
Apply mancozeb 28g in 14L water.

**Time to maturity:**
70 - 90 days

**Harvesting and storage:**
Careful handling during harvesting to prevent tubers is necessary. Harvesting is done when plants are completely dried off. Tubers can be stored for 12-14 days in well ventilated, dry store to harden the skins before transport or sale.

# 1.2.8 Tumeric
## *(Curcuma longa)*

**Cropping Season:**
August to November

**Recommended Varieties:**
- White
- Yellow

**Seed Rate:**
10 to 12 tonnes/ha

**Planting time:**
September to October

**Spacing:**
*Between rows:* 60cm

*Plants within rows:* 40cm

**Germination:**
Require free drainage

**Fertilizer/Manure:**
*NPK:* Apply twice, second and third months after planting at the rate of 625kg/ha.

*Urea:* Apply twice, second and third months after planting and before hilling at the rate of 312kg/ha)

Soil analysis should be done before fertilizer application.

Fertilizer should not be applied when it is too dry.

**Weed Control/Management:**
Hand weed or hoe regularly

**Disease Control/Management:**
*Nematodes:*
1. Root knot nematode & Burrowing nematode - hot water treatment of planting material at 51° C for 10 min.
- Crop rotation with cassava & Dalo.
- Sanitation-remove all rhizomes from the field after harvesting.
- Proper selection of seed-choose healthy seeds.

**Insect Control/Management:**
No serious pest or disease.

**Harvest/Yield/Food Value:**
10 months after planting

**Yield:**
15 to 25 tonnes

**Food Value:**
(Powder) Dietary fibre, Potassium, Iron, (very high), Calcium, Calories, Magnesium, Vitamin C, Thiamin, Riboflavin, Niacin. White tumeric has medicinal value.

# 1.2.9 Yam
## *(Dioscorea alata)*

**Recommended Varieties:**

- **Early Varieties for all Zones**
  Lokaloka, Vurai Balavu, Vurai Leka, Yasawa
- **Late Varieties for all Zones**
  Beka, Damuni, Filipai White, Filipai Yellow, Futuna, Kivi, Murapoi, Taniela Vula Leka, Veiwa.
- **Late Varieties for Dry & Intermediate Zone**
  Beka, Damuni, Filipai White, Filipai Yellow, Futuna, Kivi, Murapoi, Niudamu, Taniela Vula Balavu, Taniela Vula

**Seed Rate:**
*Ridges:* 4.2 tonnes/ha (16,670setts/ha)
*Mounds:* 3.1 tonnes/ha (12,500 mounds/ha)

**Planting Time:**
*Early Varieties:* Between June & July
*Late Varieties:* Between August to September.

**Spacing:**
Plant Spacing: Ridges - 1m between ridges & 0.6m within ridges.

**Mounds:** 1m between mounds and 0.8m within mounds.

**Fertilizer:** Poultry Manure: 10 tonnes/ha. Broadcast and mix well with soil before planting.

b) *Super Phosphate* - 200kg/ha and Murate of Potash 200kg/ha @ planting.
c) *Urea:* 200kg/ha in 3 split applications @ 8,12,16 weeks after planting.

**Weed Control/ Management:**

- Atrazine @120ml/15L of Water can use for pre emergent straight after planting.
- Paraquat at 100ml/15L of Water can be used for post emergent before canopy closure & spray shields to be used to avoid damage of plants.
- Hand weeding is also recommended.

**Disease Control/Management**
Yam Anthracnose & Dioscorea Leaf Spot:

Spray with Manzate @ 53g/16L of Water to alternate with Benomyl @ 11g/16L Water at 2 weeks interval.

- Plant resistant varieties.

*Tuber Rot:* Headsetts to be treated or sprayed with Mancozeb @ 53g/16L of Water or wood ash before planting.

- Use disease free planting material.

*Tuber Cracking:* Is caused by a nematode called R. simillis. Rotate with non host plants like Cassava, Vegetables (Cabbage, Lettuce).

**Insect Control/ Management** Tuber Scale

- Use clean planting material.
- Practice Crop rotation.
- Dip planting materials or mini setts in Diazinon @ 64mls/16L of Water before planting.

**Harvest Yield/Food Value**

- Early Varieties can be harvested from February to May.
- Late varieties can be harvested from May to July.

Harvest Index is when leaves start to senescence & are falling off.

**Yield:** 15 to 20 tonnes/ha

**Food Value:** Fibre, Potassium, Modest Amount of Vitamin B1, Vitamin C & Fair Amount of Iron.

# 1.2.10 Yaqona
## *(Piper methysticum)*

**Recommended Varieties:**
- Damu
- Dokobana Leka
- Honolulu
- Loa Kasa Balavu
- Loa Kasa Leka
- Matakaro Balavu
- Qila Leka
- Vula Kasa Balavu
- Vula Kasa Leka

**Seed Rate:**
2,500 mounds/ha (3-5 cuttings/mound)

**Planting Time:** All year round.

**Spacing:**
Traditional System:
*Between rows:* 2m
*Plants within rows:* 2m

**Fertilizer:**
*a)* *NPK:* 13:13:21 200kg/ha Basal application at planting
*b)* *Urea:* Apply 30g @ 4 months after planting.
c) Soil analysis should be done during site selection.

It is imperatively recommended to have the soil analyzed before fertilizer application.

**Weed Control/ Management:**
Paraquat @ 100ml/15L Water.
Hand weeding is highly recommended.

**Disease Control/Management:**
*Kava Die Back Disease:* Use traditional growing methods.
- Remove & destroy infected plants by burning and burying.
  Grow only on good soils with adequate shade.
- Avoid nematode host plants.
- Use clean and disease free planting materials.
- Remove weeds like mile a minute as they are host to Cucumber Mosaic Virus.

**Insect Control/ Management:**
No major insect pests.

**Harvest Yield/Food Value:**
Harvesting after 3-4 years from planting can be left longer in the field.

**Yield (Dry):**
2-3 tonnes/ha

**Food Value:**
Carbohydrate and as a laxative.

# Chapter 1.3 | Cereal Crops Grown in Fiji

# 1.3.1 Maize
## *(Zea mays)*

**Recommended Varieties:**
- Nirala

**Seed Rate:**
18kg/ha

**Planting Time:**
Can be planted all year around.

**Spacing:**
*Between rows:* 75cm
*Plants within rows:* 30cm

**Fertilizer:**
*Poultry Manure:* 10 tonnes/ha at 2 weeks before planting.
*NPK:* 13:13:21 300kg/ha at planting.
*Urea:* 150kg/ha 4 weeks after planting. (side dress)

Soil analysis should be done before fertilizer application.

**Weed Control/ Management**
Pre-emergence Atrazine at 200ml/15L of water to be applied soon after planting.

Inter-row cultivation at 4 weeks after planting.

**Disease Control/Management:**
*Downey Mildew:* Remove and burn diseased plant.
Or Spray Kocide @ a rate of 32g/16L of Water at 2 weeks interval.

**Insect Control/ Management:**
Corn Earworm, Corn leaf hopper and Maize Aphids:

Spray *Acephate* 75% a.i at 12g/16L of water (*Acephate* is sold *Sunthene*)

**Harvest Yield/Food Value:**

Harvesting after 60 to 80 days from planting.
**Yield:**
2 to 3 tonnes /ha for dry grains.

**Food Value:**
Contain Vitamin A, Protein, Dietary Fibre and Complex Carbohydrates

# 1.3.2 Dryland Rice
## *(Oryza sativa)*

**Recommended Varieties**
- Bold grain
- Deepak
- Maleka
- Nuinui
- Star
- Totoka
- Uttam

**Seed Rate:**
100kg/ha

**Planting Time:**
November to February

**Spacing:**
*Between rows:* 20cm
*Plants within rows:* 15cm
Drop seeds in furrows or use seed drill @ a depth of 4-6cm. If broadcasting, this should be even broadcasted followed by laddering.

**Fertilizer:**
*Superphosphate:* 125kg/ha @ planting.
*Muriate of Potash:* 125kg/ha @planting
*Urea:* 125kg/ha - in 2 split application : 21 days and 60 days germination.
Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
i) Narrow Leaves - Apply Propal @340ml/15 litre of Water @ 3-4 Leaf stage.
ii) Broad leaves - MCPA @ 100ml/15L of Water.

**Disease Control/Management:**
1. Brown Spot: Maintain fertility.
2. Sheath Rot: Avoid closer spacing & high level of Nitrogen.
3. Stem Rot: Plant resistant variety
4. Root Rot: Use recommended soil fertility level.
5. Blast: Plant resistant varieties.

No serious disease of Rice in Fiji.

**Insect Control/ Management:**
*Plant Hoopers:* Spray Acephate (Sunthene) 12g/16L of Water or Diazinon @ 48ml/16L of Water.

*Rice Leaf Rollers:* Apply Diazinon 48mls/16L of Water.

*Rice Army Worm:* Spray Acephate (Sunthene) at 12g/16L of Water.

**Harvest Yield/Food Value**
Harvesting after 90 days from planting.

**Yield:**
3 to 4 tonnes/ha for Star, Maleka & Totoka; 4-5 tonnes/ha for Uttam & Nuinui

**Food Value:**
Source of Thiamin, Riboflavin.

# 1.3.3 Wetland Rice
## *(Oryza sativa)*

**Recommended Varieties:**
- Improved Varieties
- Bold grain
- Deepak
- Nuinui Star
- Uttam

**Traditional Varieties:**
BG

**Seed Rate:**
80kg/ha

**Planting Time:**
Can be planted all year around.

**Spacing:**
*Between rows:* 75cm
*Plants within rows:* 30cm

**Fertilizer:**
*Superphosphate:* 125kg/ha @ planting.
*Muriate of Potash:* 125kg/ha @planting
*Urea:* 125kg/ha - in 2 split application : 21 days and 60 days germination.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
i) Narrow Leaves - Apply Propal @340ml/15L of Water @ 3-4 Leaf stages.
ii) Broad leaves - MCPA @ 100ml/15L of Water.

**Disease Control/Management:**
*Downey Mildew:*
- Remove and burn diseased plant.
- Avoid planting at high density.

**Insect Control/ Management:**
*Corn Earworm, Corn leaf hopper and Maize Aphids:*

Spray *Acephate* 75% a.i at 12g/16L of water (Acephate is sold as Orthene & Sunthene).

**Harvest Yield/Food Value:**
Harvesting after 60 to 80 days from planting.

**Yield:**
2 to 3 tonnes/ha for dry grains.

**Food Value:**
Contain Vitamin A, Protein, Dietary Fibre and Complex Carbohydrates

# Chapter 1.4 | Pulses Grown in Fiji

# 1.4.1 Cowpea
## *(Vigna uguiculata)*

**Recommended Varieties:**
- Tara
- Mana
- Rachna

**Seed Rate:**
Tara & Mana - 28kg/ha
Rachna - 23kg/ha

**Planting Time:**
Can be planted all year around.

**Spacing:**
Mechanised:

Between rows: 65cm
Plants within rows: 10-20cm

Manual:
*Between rows:* 50cm
*Plants within rows:* 10 -20cm

**Fertilizer:**
Mixture of 100kg Blend A and 100kg Blend, applied as basal application.

* Foliar application of Bio Grow at the rate of 150ml/15L water at
i) 2-3 weeks after germination &
ii) at 5 weeks after germination.

Apply *Bio Harvest* at the rate of 150ml/15L of Water from flowering onwards every fortnight.

**Weed Control/ Management:**
Hoeing or mechanical inter row cultivation.

**Disease Control/Management:**
Cercospora Leaf Spot, Round Spots, Reddish brown or Purple in color. Not often seen until flowering.

**Chemical Control:** Apply Benomyl @ 11g/16L water.
Or *Mancozeb* @ 53g/16L.
**Cultural Control:** Crop rotation and general field sanitation. Clean seeds should be used.

**Insect Control/ Management:**
For control of Maruca testulalis (Pod borer) Apply Lannate @32ml/16L Water.

For control of Aphids, Leaf Miners & other pests. Dimethote (sold as Rogor) @16ml/16L Water or Suncloprid @ 4 - 8ml/15L Water or Bifenthrin @ 15-20ml per 16L water.

Spray when eggs of Maruca appear on leaves.

**Harvest Yield/Food Value:**
*Harvest green pod:* 55 - 90 days after planting.

*Dry:* Harvest 90-120 days after planting.

*Yield:* 3-6 tonnes/ha green pod.

*Dry (Dhal):* 1.5-3 tonnes/ha.

**Food Value:** Good source of Vitamin B - Complex, group of Vitamin, Vitamin C also has useful amount of Iron, Zinc & Calcium.

# 1.4.2 Mung Bean
## *(Vigna radiata)*

**Recommended Varieties:**
- Jyoti
- Aakarshan

**Seed Rate:**
18-22kg/ha
Treated seeds can be kept up to six months at room temperature.

**Planting Time:**
Can be planted all year around.

**Spacing:**
***Mechanised:***
*Between rows:* 65cm
*Plants within rows:* 10-20cm

***Manual:***
*Between rows:* 50 cm
*Plants within rows:* 10 -20cm

**Fertilizer:**
Mixture of 100kg Blend A and 100kg Blend, applied as basal application.

* Foliar application of Bio Grow at the rate of 150ml/15L water at
i) 2-3 weeks after germination &
ii) at 5 weeks after germination.

Apply Bio Harvest at the rate of 150ml/15L of Water from flowering onwards every fortnight.

Soil analysis to be done before any fertilizer application.

**Weed Control/ Management:**
Hoeing or mechanical inter row cultivation.

**Disease Control/Management:**
*Cucumber Mosaic Virus:* Malformed leaves with yellow & green blister. Remove infected plants & destroy away from field.

Control aphids (vector)
Cercospora Leaf Spot, Round Spots, Reddish brown or Purple in color. Not often seen until flowering.

Chemical Control:
Apply Benomyl @ 11g/16L water.
Or Mancozeb @ 53g/16L.
Cultural Control: Crop rotation and general field sanitation. Clean seeds should be used.

**Insect Control/ Management**
Maruca, Leaf Miners & other Pests: Apply Lannate @32ml/16L Water.

For control of Aphids, Leaf Miners & other pests. Apply Dimethote (sold as Rogor) @16ml/16L Water or Suncloprid @ 4 - 8 ml/15L Water or Bifenthrin @ 15-20ml per 16L water. Spray when eggs of Maruca appear on leaves.

**Harvest Yield/Food Value**
*Harvest green pod:* 55 - 90 days after planting.
*Dry:* Harvest 90-120 days after planting.

**Yield:** 3-6 tonnes/ha green pod.
*Dry (Dhal):* 1.5-3tonnes/ha.

**Food Value:** Good source of Vitamin B - Complex, group of Vitamin, Vitamin C also has useful amount of Iron, Zinc & Calcium.

# 1.4.3 Peanut
## *(Arachis hypogea)*

**Recommended Varieties:**
- Volasiga
- Local Spanish

**Seed Rate:**
Local Spanish - 115kg/ ha (unshelled)

Volasiga - 107kg/ha (Unshelled)

**Planting Time:**
Can be planted all year around but avoid planting in wet months as yield will be low.

The best planting time is from February to October.

**Spacing:**
***Mechanised:***
*Between rows:* 65cm
*Plants within rows:* 10-20cm

***Manual:***
*Between rows:* 50 cm
*Plants within rows:* 10 -20cm

**Fertilizer:**
Ammomium Sulphate - 110kg/ha.
Single Superphosate 400kg/ha, Muriate of Potash - 100kg/ha
Or
Mixture of 100kg Blend A and 100kg Blend, applied as basal application during planting

* Foliar application of Bio Grow at the rate of 150ml/15L water at
i) 2-3 weeks after germination &
ii) at 5 weeks after germination.

Apply Bio Harvest at the rate of 150ml/15L of Water from flowering onwards every fortnight.

**Weed Control/ Management:**
Hoeing or mechanical inter row cultivation.

**Disease Control/Management:**
*Leaf Spot:* Reddish brown to dark brown lesions on the upper leaf surface.

*Chemical Control:*
Mancozeb @ 32g/16L Water.
Crop rotation & field sanitations. Use clean seeds.

*Rust:* Spray Mancozeb @ 32g/16L Water as well Crop rotation of crops from different families.

**Insect Control/ Management:**
*Cut Worms:* The younger plants are severed or partially at ground level.

Spray *Suncis* @ 8ml/ 16L Water
Or
*Steward* at 8ml/16L of Water.

**Harvest Yield/Food Value:**
*Volasiga:* Harvest at 110-130 days from planting.
*Local Spanish:* Harvest at 105 days from planting.

**Yield (dry):** Volasiga: 2.5 to 3.6 tonnes/ ha

Local Spanish; 1.5-2 tonnes/ha

**Food Value:**
Good source of B-complex of Vitamins, Vitamin C, Iron, Zinc & Calcium.

# 1.4.4 Pigeon Pea
## *(Cajanus cajan)*

**Recommended Varieties**
Improved Varieties
(Non Seasonal)
- Uasivi (green pod)
- Bhapur (Dry Seed)

**Seed Rate**
Uasivi - 20kg/ha
Bhapur - 23kg/ha
Kamica - 30kg/ha

**Planting Time:**
Seasonal - February to June.
Non Seasonal: February to October
Avoid planting in the wet season.

**Spacing**
***Mechanised:***
*Between rows:* 65cm
*Plants within rows:* 10-20cm

***Manual:***
*Between rows:* 50 cm
*Plants within rows:* 10 -20cm

**Fertilizer:**
Mixture of 100kg Blend A and 100kg Blend, applied as basal application during planting

* Foliar application of Bio Grow at the rate of 150ml/15L water at

i) 2-3 weeks after germination &
ii) at 5 weeks after germination.

Apply Bio Harvest at the rate of 150ml/15L of Water from flowering onwards every fortnight.

Soil analysis to be done before any fertilizer application.

**Weed Control/ Management**
Hoeing or mechanical inter row cultivation.

**Disease Control/Management**
*Damping Off:* Attack seedlings 1-3 weeks old which infected plants wilt and die.

Treat seeds with Thiram.
Spray Mancozeb @ 32g/16L Water.

All diseased plants should be destroyed & practice crop rotation.

**Insect Control/ Management:**
Bean Pod Borer (Maruca testulalis):
Apply *Lannate* @ 32ml/16L of Water
Or
*Sundothrin* @ 17-22ml per 16L of Water.

**Harvest Yield/Food Value**
*Dry:* Harvest after 120-150 days from planting.

**Yield (dry):**
Volasiga: 2 to 4 tonnes/ ha

*Green Pod:* Harvest after 95-120 days from planting.

**Food Value:**
Good source of B-complex of Vitamins, Vitamin C, Iron, Zinc & Calcium.

# 1.4.5 Urd
## *(Vigna mungo)*

**Recommended Varieties:**
- Kiran
- Raikivi

**Seed Rate:**
17kg/ha

Treated seeds can be kept up to six (6) months at room temperature.

**Planting Time:**
Planting season is from February to October.

Avoid planting in the wet season.

**Spacing:**
***Mechanised:***
*Between rows:* 65cm
*Plants within rows:* 10-20cm

***Manual:***
*Between rows:* 50cm
*Plants within rows:* 10 - 20cm

**Fertilizer:**
Mixture of 100kg Blend A and 100kg Blend, applied as basal application during planting

* Foliar application of Bio Grow at the rate of 150ml/15L water at
i) 2-3 weeks after germination &
ii) at 5 weeks after germination.

Apply Bio Harvest at the rate of 150ml/15L of Water from flowering onwards every fortnight.

Soil analysis to be done before any fertilizer application.

**Weed Control/ Management:**
Hoeing or mechanical inter row cultivation.

**Disease Control/Management:**
*Powdery Mildew:* Small white powdery on the upper leaf surface. Affected leaves turn yellow & later brown. Pods are malformed and leaf defoliation occurs.

Spray *Benomyl* at 11g/16L of Water twice at 10 - 14 days interval.

**Insect Control/ Management:**
For control of Maruca, Leaf Miner & other *Pests use:* Apply Lannate at 32ml/16L of Water.
Spray when eggs of Maruca are noticed on flower buds.

*Aphids:* Apply Dimethoate (Rogor) at 16ml/16L Water OR Suncloprid at 4ml to 8ml/16L Water OR Bifenthrine at 15 - 20ml/16L of Water.

**Harvest Yield/Food Value:**
Harvest dry pods at 65-90 days from Planting.

**Yield (dry):**
1-1.8 tonnes/ha

**Food Value:**
Good source of B-complex, Group of Vitamins, Vitamin C, Iron, Zinc & Calcium.

# Chapter 1.5 | Tree and Fruit Crops Grown in Fiji

# 1.5.1 Avocado Pear
## *(Persia americana)*

**Fruiting Season:**
February to April

**Recommended Varieties:**
Local Selection

**Seed Rate:**
123 plants/ha

**Planting time:**
All year round

**Spacing:**
Plant 9m x 9m apart and away from other trees and buildings

**Germination:**
Seeds are quick to germinate

**Fertilizer/Manure:**
*NPK:* 13:13:21 - Younger plants under five years, 230g/per plant in 1st year and thereafter apply 230g/plant per each year of the plant. For e.g. in the 2nd year apply 460g/plant and 690g in the 3rd year and so on until five years and 1kg/plant/year for plants over 5 years.

Heavy mulch around the base of the plant ensures steady growth. Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
*Paraquat* at 100ml/15L of water (Sold as *Gramazone, Agazone & Royal paraquat*)
Or
*Glyphosate* at 150ml to 200ml/15L of water (Sold as Round up, Champion 450, Rainbow & Rambo)

**Disease Control/Management:**
*Root Rot:* Apply Sundomil at 60g/15L of water.

Maintain good drainage. Prune regularly

**Insect Control/Management:**
No significant insect pests of concern

**Harvest/Yield/Food Value:**
Normally fruits appear after 6 to 7 years from planting but grafted/budded plants come into bearing earlier at about 4 to 5 years.

**Yield:**
About 10 to 15 tonnes/ha from an orchard of about 10 to 12 years.

Prune regularly.

**Food Value:**
Dietary fibre, Potassium & Vitamin C

# 1.5.2 Breadfruit *(Artocarpus altilis)*

**Fruiting season:**
December to May

**Recommended Varieties:**
- Uto Dina
- Uto Dina (Kasa leka)
- Bale Kana (Dina)
- Bale Kana (Waikava)

**Seed Rate:**
69 plants/ha

**Planting time:**
Planting is recommended during the wet season (November to March)

**Spacing:**
Between rows: - 12m
Plants within rows: - 12m

Use Root suckers, Root cuttings, and Marcotted plants as planting materials

**Fertilizer/Manure:**
*NPK:* 13:13:21 can be used in small amounts as basal and side dress

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
Ring weed around plants and spray Glyphosate between plants at 150ml to 200ml/15L of water (Sold as Round up, Champion 450, Rainbow & Rambo.

Apply herbicides carefully around the plants.

**Disease Control/Management:**
*Fruit rot:* Good site selection and field sanitation.

Remove diseased fruits to avoid spread of disease.
*Brown Stem rot:*
Remove diseased fruits to avoid spread of disease

**Insect Control/Management:**
Fruit flies: Trees must be sprayed with Protein Bait each week for a period of seven weeks prior to harvest for export market.

**Harvest/Yield/Food Value:**
20 to 40 tonnes/ha

Plants obtained from marcotting can start flowering within a year and production achieved in 2nd year.

**Food Value:**
Fair source of Vitamin C, rich in Fibre and good source of Iron and Calcium.

# 1.5.3 Passionfruit *(Passiflora edulis)*

**Recommended Varieties**

- Local Yellow

**Seed Rate**
1111 Seedlings/ha

**Planting Time:**
Best planting time is in the cool and dry months (April to September)

**Spacing:**
Between Rows : 3m
Plants within rows : 3m

*Posts:* 3m within rows
6.2m within rows.

Seeds germinate in 10 days after sowing, ready for transplanting within 6-8 weeks.

**Fertilizer:**
*NPK:* 13:13:21 90g/plants at planting, 230g/plant every 3 months interval for 1st year & 300g/plant every 3 months interval for 2nd & 3rd Year.

Hilling to be carried out after every fertilizer application.

**Weed Control/ Management:**
Ring weeding during early stages of growth. When plants are well established, ring weed around the plants & carefully spray with Glyphosate @ 150ml/15L Water.

Hand pollination to be practiced to obtain high yield, to be carried out in the afternoon; after 2 pm.

Integrate apiculture farming with passionfruit for pollination purpose.

**Disease Control/Management:**
*Brown Spot:* Controlled by Benomyl at 11g/16L of Water.

*Collar Rot:* The disease can be controlled by good site selection & planting on raised bed.

**Insect Control/ Management**
Red Spider Mite: Controlled by spraying Dimethoate (Rogor) at 16ml/16L of Water.

Or

Multi Guard @ 8-10ml/16L of Water

**Harvest Yield/Food Value**
**Yield:**
*1st Year:* 12-18 tonnes/ha
*2nd Year:* 20-25tonnes/ha
*3rd Year:* 10-12tonnes/ha

**Food Value:**
Good Source of Iron and Vitamin C.

# 1.5.4 Pineapple
## *(Ananas comosus)*

**Fruiting Season:**
Main Season November to April

**Off Season:**
February to October.

**Recommended Varieties:**
- Smooth Canyenne (Large juicy fruit)
- Ripley Queen
  (Small sweeter fruit - thorny leaves)

**Seed Rate:**
Sloppy Land (37,037 suckers/ha)
Flatland - 48,000 suckers/ha

**Planting Time:**
Best time to plant is in the dry season (April to July) to prevent base rot.

On flat lands, used raised beds.
Practice phase planting for all year round production.

**Spacing:**
*Sloppy Land:* 1.2m between ridges, 0.6m between rows per ridge & 0.3m between plants (Double rows)

*Flat Land:* 1.4m between ridges, 0.4m between rows per ridge and 0.2m between plants (Double rows) Best planting material are suckers weigh 250-300g or 25-30cm in height.

**Fertilizer**
*Sloppy Land:*
Super Phosphate: 250kg/ha @Planting.
*Urea:* 110kg/ha @ 1 month after planting.
*NPK:* 13:13:21 @ 250kg/ha @ 4months interval after planting.

**Off Season**
Apply Eithrel @ 100ml plus 1kg Urea plus 250g Borax in 50L Water. Apply Dose in the centre of the plant (d-leaf length of 65cm or >65cm, rate of 50ml/plant; application to be done after 3pm. Repeat application if it rains for 3 hours

**Weed Control/ Management:**
Manual Weeding or inter row cultivation from 1-3 months after planting.

Then use herbicides to control weeds :
*Karmex DF* (80% Diuron) at 100g/15L of water to be applied on plots before flowering & fruitset.

**Disease Control/Management:**
*Heart & Root Rot:* Planting during dry season with good field drainage.

*Base Rot:* Dip the planting material in fungicide before planting. Dithane M45 (Mancozeb) 23g/16L of Water. Or Apply Benomyl @ 11g/16L of Water.

**Insect Control/ Management:**
*Mealy Bugs:* Spray *Malathion* @ 32mls in 16 litre of Water or *Suncloprid* at 4 - 8ml/16L of Water Or *Bifenthrin* at 15 to 20ml/16L of Water Or *Diazinon* at 60ml/16L of Water.

**Harvest Yield/Food Value:**
**Yield:**
*Planted Crop:* 40-70tonnes/ha with fruit weight 1-1.5kg.
*1st Ratoon:* 30-40tonnes/ha with ~ weight of 1.0-1.5kg
*2nd Ratoon:* 20 to 25tonnes/ha with ~ weight of 1-1.2kg.

**Food Value:**
Good source of Vitamin C and Vitamin B1 & Fibre.

# 1.5.5 Watermelon
## *(Citullus lanatus)*

**Recommended Varieties:**
- Charleston Grey
- Sugar Babe
- Farmers Giant

**Seed Rate:**
1.5-2kg/ha

**Planting Time:**
April to September during the cool season but can be grown all year round.

**Spacing:**
*Between Rows:* 3m
*Plants within Rows:* 1m
*Germination:* 6 - 10 days after sowing

**Fertilizer:**
*Poultry Manure:* 10 tonnes/ha. Mix well in the soil 2 weeks before planting

*NPK:* 13:13:21 200kg/ha basal at planting.
*Urea:* 100kg/ha; Side dress at 2 & 4 weeks after planting.

Soil analysis to be done before any fertilizer application.

**Weed Control/ Management:**
Hand weeding of hoeing as necessary.
Practice of mulching to retain moisture and control weeds.

**Disease Control/Management:**
*Powdery Mildew, Gummy Blight, Anthracnose :*
Spray with Kocide at the rate of 32g/16L of Water for Disease Control.

*Blossom End Rot:*
Have soil analyzed for level of K, and Ca. High level of N and low level of K & Ca causes blossom end rot.

Keep your crop free from insects to avoid spread of viral diseases.

**Insect Control/ Management:**
*Aphids:* Apply Dimethoate at 16ml/16L of Water OR Suncloprid at 4mls - 8ml/16L Water OR Bifenthrin at 15-20 ml/16L of Water.

*Thrips:* Apply Confidor @ rate of 5.3mls/16L Water OR Suncloprid @ 4-8ml/16L Water OR Bifenthrin @ 15-20ml/16L Water.

*Pumpkin Beetle:* Apply Malathion @ 45ml/16L Water.

**Harvest Yield/Food Value:**
Harvest at 70-120 days from planting.

**Yield:** 15-20 tonnes/ha

**Food Value:** Vitamin C

# 1.5.6 Banana
## *(Musa sapientum)*

**Recommended Varieties:**
- Veimama
- Jaina Balavu
- Jaina Leka
- Lady Finger
- Smith
- Mili
- Timoci

**Seed Rate:**
1666 suckers/ha

**Planting Time:**
Recommended from October to March otherwise all year round.

**Spacing:**
*Between Rows:* 3m
*Plants within Rows:* 2m

*Planting Materials:* Select healthy and disease free as planting materials.

**Fertilizer:**
*NPK:* 13:13:21 90g/plant at basal application at planting.

230g/plant at 3 split applications, @ 3 months, 6 months & 9 months after planting; Apply fertilizer around the plant based on canopy diameter.

Soil analysis should be done before fertilizer application. Banana usually planted on fertile soil for quality fruits & high yields.

**Weed Control/ Management:**
Ring weeding, spray with Glyphosate between plants @ 150-200ml/15L of Water.

**Disease Control/Management:**
*Fungal & Viral Disease:* Remove infected plants & bury. Practice good field sanitation.

*Black Sigatoka Disease* - No effective chemical control. Diseased damaged can be minimized through proper cultural practices; good planting materials, hot water treatment for Nematodes. For nematodes, treat soil with Basamid at 60g per square meter, mix well with soil & cover with plastic after treatment.

**Insect Control/ Management:** *Banana Aphids:* (Vector for transmitting virus). Spray Dimethoate (Rogor) @ 16ml/16L of Water.

*Banana Weevil:* Keep plantation clear of any plant debris & weeds.

Or Spray with *Bifenthrin:* 15-20ml/16L of Water.

*Banana Root Nematodes:* Use suckers from non infected areas. Practices good husbandry practices.

**Harvest Yield/Food Value:**
Fruits appear after 9-10 months from planting & ripens about 3 months from fruit set.

**Yield (dry):** 1666 bunches in 1st year, 2500 bunches in 2nd Year if 2 suckers are maintained per stool.

**Food Value:** Potassium, Vitamin A & Vitamin C

# 1.5.7 Cocoa
## *(Theobroma cacao)*

**Recommended Varieties:**
- Amelonado
- Trinitario
- Keravat

**Seed Rate:**
2500 plants/ha

**Planting Time:**
Can be planted all year around but best planting time:
*Dry Zone:* Mid September to December
*Wet Zone:* October to December.

**Spacing:**
*Between Rows:* 2m
*Plants within Rows:* 2m
*Planting Materials:* Select healthy and disease free as planting materials.

**Fertilizer:**
*Super Phosphate:* Apply 10g per plant, basal application at planting.

*NPK:* 13:13:21 200kg/ha @ 2 split application, @ 4 months and 8 months.

Apply fertilizer around the plant based on canopy diameter. Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Ring weeding, spray with *Glyphosate* between plants @ 150-200ml/15L of Water or *Paraquat* at 100ml/15L of Water.

**Disease Control/Management**
*Black Pod:* Spray with Kocide at 53g/16L of Water every 2 weeks.

*Canker:* Remove & destroy diseased plants.
*Sanitation:* Remove disease parts away from the Cocoa field, burn & bury. Plant the recommended Amelonado variety.

Remove black pods regularly & bury or burn outside the plantation.

Prune shade trees & overgrown Cocoa branches.

**Insect Control/ Management**
*Green Semi Hopper:* Spray Acephate (sold as Sunthene) @ 12g/16L Water

**Harvest Yield/Food Value:**
Harvest @ 3 years after planting.

*Yield:* 2.5 tonnes/ha Wet beans.
Or
2.0 tonnes/ha Dry

**Food Value:**
Source of Thiamin, Niacin & Vitamin B12.

# 1.5.8 Coconut
## *(Cocos nucifera)*

**Recommended Varieties:**
- Fiji Tall
- Rotuman Tall
- Niu Leka
- Niu Magimagi
- Niu Drau
- Niu Kitu
- Niu Yabia
- Malayan Red Dwarf
- Malayan Green Dwarf
- Malayan Yellow Dwarf

**Hybrids:**
- Malayan Red Dwarf x Rotuman Tall
- Malayan Yellow Dwarf x Rotuman Tall

**Seed Rate:**
123 plants/ha

- Propagated through seedlings raised from selected seed nuts, 6 to 7 months old seedlings are used as planting materials.

**Planting Time:**
Best time for planting is at the onset of the rainy season - October to April

**Spacing:**
Spacing depends upon the planting system & soil type.
- Triangular : 9m x 9m
- Square : 10m x10m

**Fertilizer:**
Ammonium Sulphate - Year 1 - 0.3kg/tree, Year 2: 0.6kg/tree, Year 3: 0.9kg/tree, Year 4: 0.9kg/tree Triple Superphosphate: Year 1: 0.1kg/tree, Year 2: 0.2kg/tree, Year 3: 0.3kg/tree, Year 4: 0.4kg/tree; Muriate of Potash - Year 1: 0.4kg/tree; Year 2: 0.8kg/tree; Year 3: 1.2kg/tree; Year 4: 1.2kg/tree; Year 5:1.2kg/tree; Year 6 1.2kg/tree.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Ring weeding, spray with Glyphosate between plants @ 100ml/15L of Water or
Paraquat at 100ml/15L of Water.

**Disease Control/Management:**
*Bud Rot:* The disease affects palms of all ages and all varieties of Coconuts.

For Seedlings: Monthly spray *Kocide:* 32g in 16L of Water or Remove and destroy diseased seedlings.

For older plants: Remove and destroy diseased plants.

**Insect Control/ Management:**
1. Rhinoceros Beetle
2. Stick Insects

Rhinoceros Beetle controlled by biological control methods, using virus, fungus & pheromone traps. Stick Insects is controlled by Cultural method, Good field sanitation, Parasitoid - Paranastatus nigriscutilatus.

**Harvest Yield/Food Value**
Bearing
*Tall:* 5-7 years to bear nuts
*Dwarf:* 3-4 years to bear nuts.
*Hybrid:* 3-4 years to bear nuts.

**Yield:** Tall : 0.7
- 1.3 tonnes/ha (dried Copra)

**Dwarf:** 0.7 - 0.8 tonnes/ha (dried Copra)
Hybrid 2-3 tonnes/ha (dried Copra)

**Food Value:**
Vitamin C, Vitamin B1, B2 & Iron.

# 1.5.9 Kura (Noni)
## *(Morinda citrifolia)*

**Cropping Season:**
All year round

**Recommended Varieties:**
- Local Selections
  Small fruit varieties are preferred.

**Seed Rate:**
625 seedlings/ha

**Planting Time:**
Can be planted all year round but best during October to March enhance plant growth.

**Spacing:**
*Between rows:* 4m
*Plants within rows:* 4m

**Germination:**
Seeds germinate in 25 - 30 days and within 12 - 16 weeks, plants are ready for transplanting.

**Fertilizer/Manure:**
Kura is grown naturally (organically) to be planted in new areas.

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
Ring weed round and in between the plants during establishment stage. No herbicides to be used if grown organically.

Pruning of main shoots to dwarf the trees for ease of harvest.

**Disease Control/Management:**
No economic diseases

**Insect Control/Management:**
No economic pests

**Harvest/Yield/Food Value:**
Fruiting will start at 13 - 15 months after transplanting.

**Yield:**
1.0 to 1.5kg/tree/week under optimum management practices.

**Food Value:** Vitamin C.

# 1.5.10 Mango
## *(Mangifera indica)*

**Recommended Varieties**
- Kensington
- Tommy Atkins
- Mapulehu
- Mexican Kent
- Parrot
- Mango Dina
- Peach
- Baramasia

**Seed Rate:**
125 plants/ha

**Planting Time:**
Planting is recommended during the Wet Season (November to March).

**Spacing:**
Between Rows: 9m
Plants within Rows: 9m

**Germination:**
Grafted seedlings enhance early flowering & fruiting. Grafted plants can be produced from reliable nursery few days before transplanting.

**Fertilizer:**
*NPK:* 13:13:21 110g/plant @ planting.

250g/plant @ 6 months interval until 3 years after planting.

*Bearing Trees:*
2kg-3kg annually.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Ring weeding, spray with Glyphosate between plants @ 150-200ml/15L of Water or Paraquat at 100ml/15L of Water.

**Disease Control/Management:**
Ring weeding, spray with Glyphosate between plants @ 150-200ml/15L of Water or Paraquat at 100ml/15L of Water.

**Insect Control/ Management:**
*Fruit flies:* Set up protein bait traps. Pick all the fallen fruits & clean the surrounding.

*Mango Stone Weevil:* Good field sanitation recommended. Bury all fallen fruits to prevent pests population build up.

**Harvest Yield/Food Value:**
Grafted plants start to fruit within 3 years. Yields vary depending on the varieties age of tree & weather conditions @ flowering.

**Yield:**
*Improved Varieties:* 25-80kg/tree in 5th to 7th year.

70-150kg/tree in 8th to 15th Year.

**Food Value:**
Rich in Vitamin A as well as Vitamin C.

# 1.5.11 Papaya
## *(Carica papaya)*

**Recommended Varieties**
- Sunrise Solo (Export Variety)
- Waimanalo (Local markets)

**Seed Rate**
1667 plants/ha

**Planting Time:**
Can be planted all year round.

**Spacing:**
Between Rows: 3m

Plants within Rows: 2m

**Germination:**
The seeds germinate in 10 to 12 days after sowing. In cooler seasons it takes longer 18 to 21 days. The seedlings are grown in plastic pots for 6 to 7 weeks after sowing before transplanted in field.

**Fertilizer:**
NPK: 13:13:21 90g/plant at planting. 140g/plant at 3months after planting and thereafter 230g/plant at every 3 months interval. Borax: 10g/plant at planting and 10g/plant after 4 to 5 months and thereafter 10g/plant every 6 months. Soil analysis should be done before fertilizer application.

**Weed Control/ Management**
Ring weed around and in between the plants during early stages of growth. When plants are well established, ring weed around the plants and carefully spray Glyphosate at 150ml to 200ml/15L of water (Sold as Round up, Champion 450, Rainbow & Rambo) between the plants. Plastic mulching at planting.

**Disease Control/Management**
*Anthracnose:* Attacks ripe fruits, sunken brown spots that enlarge and results in rot as fruits ripen. Apply Benomyl at 10g/15L of water (Sold as Benlate) or Kocide at 30g/15L of water to prevent fungal infections or Sundomil at 50g/15L of water. **Stem & Root rot:** Plant pawpaw in welldrained fields.

*Phytophthora stem and fruit rot:* Apply Mancozeb at 50g/15L water or Kocide at 30g/15L of water to prevent fungal infections or Sundomil at 50g/15L of water on the ground around the root area.

*Black leaf spot:* Apply Mancozeb 50g/15L of water.

**Insect Control/ Management**
Fruit fly: Female flies lay eggs under the skin of ripe, fallen, damaged or rotten fruits and deteriorate the quality of fruits. Harvest at color break, spray Protein bait & Malathion at 30ml/15L of water on plants. Good field sanitation, remove and bury fallen fruits.

**Harvest Yield/Food Value:**
Flowers and fruit setting after 5-7 months from planting and fruit ripens at 8 to 10 weeks after flowering. Maximum yield of 60 to 80 tonnes/ha can be achieved through minimizing post harvest loses. Economic life 3 years from planting to get quality fruits for export market.

**Food Value:** Excellent source of Vitamin A and Vitamin C.

# 1.5.12 Plantain
## *(Musa balbisiana)*

**Fruiting Season:**
October to April. Fruiting time may vary depending on variety

**Recommended Varieties:**
- Horn type (Qamure)
- Red "Vudi" (Damuloa)
- Green tall
- Green thick finger
- Paka (Blue java)
- Black leaf midrib
- Vudi mami

**Seed Rate:**
1666 suckers/ha

**Planting time:**
October to March

**Spacing:**
*Between rows:* 3m
*Plants within rows:* 2m
*Planting materials:* Healthy and disease free suckers should be selected for planting

**Fertilizer/Manure:**
Banana usually planted on fertile soil for quality fruits and high yields

*NPK:* 13:13:21
90g/plant during planting.
230g/plant every 4 months.

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
Carefully ring weed around the plants and spray Glyphosate at 150ml to 200ml/15L of water between plants (Sold as Round up, Champion 450, Rainbow & Rambo)

**Disease Control/Management:**
There are a number of fungal and viral diseases in banana. The symptoms can be easily mistaken.
*Sigatoka Disease:* Apply Punch fungicide (Bell injection) at 80ml/15L of water.

For Bunchy top virus, remove the infected plants from the field and bury. Practice good field sanitation. Use disease free planting materials.

**Insect Control/Management:**
Banana Aphid: (Vector for transmitting virus). Spray *Dimethioate* at 15ml/15L of water (Sold as Rogor) or

*Suncloprid* at 3.75 to 7.5ml/15L of water or *Bifenthrin* at 14 to 18ml/15L of water.

*Banana weevil:* Keep plantation clear of any plant debris and weeds.

*Banana root nematodes:* Use suckers from non-infected areas. Good husbandry practices.

**Harvest/Yield/Food Value:**
Fruits appear after 9 to 10 months from planting and ripens about 3 months from fruit set.

**Yield:**
30 to 40 tonnes/ha.

**Food Value:**
Source of dietary fibre, Potassium, Calcium & Magnesium

# 1.5.13 Soursop
## *(Annona muricata)*

**Fruiting Season:**
October to April

**Recommended Varieties:**
- Local Selection

**Seed Rate:**
500 plants/ha

**Planting Time:**
Can be planted all year round

Planted during November to March enhance plant establishment.

**Spacing:**
*Between rows:* 4.5m
*Plants within rows:* 4.5m

*Germination:* Propagated by seeds, cuttings or grafted on same rootstock. Seedlings are grown in nursery and transplanted in to the field at 8 to 10 leaf stage.

**Fertilizer/Manure:**
*NPK:* 13:13:21 90g/plant during planting. 230g/plant at every 3 months up to 3 years after planting. Thereafter 1kg/plant every 6 months.

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
Ring weed the plants and spray Glyphosate at 150ml to 200ml/15L of water (Sold as Round up, Champion 450, Rainbow & Rambo)

**Disease Control/Management:**
Root rot can be a problem if grown in waterlogged areas.

Avoid planting in poorly drained sites.

No major disease of economic importance.

**Insect Control/Management:**
Birds and Bats eat ripe fruits on the tree.

Harvest fruits before full ripeness

**Harvest/Yield/Food Value:**
Fruiting starts in 2 to 4 years after planting.

**Expected yields:**
8 to 10 tonnes/ha/year after 3 years from planting.

Economic life 10 to 12 years.

**Food Value:**
Fair source of Protein, Dietary fibre, Potassium and Calcium.

# Chapter 1.6 | Spices Grown in Fiji

# 1.6.1 Cardamom
## *(Elettaria cardamomum)*

**Recommended Varieties:**
- Malabar
- Mysore

**Seed Rate:**
1.1 kg/ha
3086 plants per hectare.

**Planting Time:**
Can be planted all year round.

**Spacing:**
*Between Rows:* 1.8m

*Plants within Rows:* 1.8

**Germination:**
Seedlings are raised and are transplanted after 3-4 months into the first nursery beds, then transplanted again after 6 months to the second nursery beds.

The younger plants are hardening off and are planted out in the fields when 2 years old.

**Fertilizer:**
*NPK:* 13:13:21 200kg/ha @ planting.

*Urea:* 100kg/ha
to be apply as side dress after 8 weeks from planting.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Ring weeding, spray with Paraquat at 100ml/15L of Water.

**Disease Control/Management:**
*Wilting of Planting:* Remove diseased plants and burn.
- Improve drainage.

**Insect Control/ Management:**
Thrips, Caterpillars & Weevil borers :
Spray with Confidor @ 8ml/16L of water.

**Harvest Yield/Food Value:**
Harvesting is carried out in the 3rd year. Fruits ripens over an extended period, usually gathered at intervals of 30-40 days.

**Yield:**
250-500kg (Dry)

**Food Value:**
Food flavour.

# 1.6.2 Cinnamon
## *(Cinnamomum verum)*

**Recommended Varieties**
- Navashree

**Seedling Rate**
277 plants/ha

**Planting Time:**
Can be planted all year round.

**Spacing**
Between Rows: 3m

Plants within Rows: 3m

**Fertilizer:**
NPK : 13:13:21 200kg @ planting.

Urea : Apply after 8 weeks at the rate of 100kg/ ha.

Practice of mulching is recommended to discourage weed invasion and acts as a source of manure to the plants.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management**
Ring weeding, spray with
Paraquat at 100ml/15litre of Water.

**Disease Control/Management**
Leaf Spot and Dieback - Remove diseased plants and bury.
- Improve drainage system.

**Insect Control / Management**
No serious pest of cinnamon in Fiji.

**Harvest Yield/Food Value:**
Harvesting of chip will commence at Year 4-Year 5.

The side stems are removed and the bark is stripped off. Cinnamon bark is only obtained from stems that are between 1.2 and 5cm in diameter.

**Yield :** 2.5 ton/ha

**Food Value:**
Food Flavour.

# 1.6.3 Nutmeg
## *(Myristica fragrans)*

**Recommended Varieties:**
- Vishwashree
- Konkan Sugandha
- Konkan Swad

**Seed Rate:**
156 plants/ha

**Planting Time:**
Can be planted all year round.

**Spacing:**
*Between Rows:* 8m

*Plants within Rows:* 8m

**Germination:**
Seedlings are raised and are transplanted after 6 months to the field.

Regular watering is necessary for healthy plants.

**Fertilizer:**
NPK : 13:13:21 110g/plant @ planting.

*Bearing Trees:*
2kg annually.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Ring weeding, spray with

Paraquat at 100ml/15L of Water.

**Disease Control/Management:**
No serious disease of nutmeg in Fiji.

**Insect Control/ Management:**
Thrips & Weevil borers:
Spray with Confidor @ 8ml/16L of water.

**Harvest Yield/Food Value**
Bearing starts from 6-7 years after planting. The mature fruits when they start splitting are harvested.

**Yield:** 5-7kg/tree dried nuts.

**Food Value:**
Medicinal & Food Flavour.

# 1.6.4 Vanilla
## *(Vanilla fragrans)*

**Recommended Varieties:**
- Bourbon vanilla (Vanilla planifolia)

**Seed Rate:**
1111 plants/ha

**Planting Time:**
Can be planted all year round.

**Spacing:**
*Between Rows:* 3m
*Plants within Rows:* 3m

*Cutting:* 1.5m long sprout in 15-20 days after planting.

**Fertilizer:**
Require heavy mulching: 20-30 cm around base. (Coconut husk, dry leaves & rotten decaying timber can be safely used as mulch).

*Poor Soils:* Apply 20-30g of Nitrogen & Phosphorus, 60-100g Potash per Vine per year beside the organic mulch.

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Hand weeding or use of brush cutter at least four times a year.

**Disease Control/Management:**
*Poty Virus:* Remove & destroy infected plants. Use healthy and disease free planting materials. Wash hands after handling infected plants. Wait for a month for the virus to die, then replant the area.
Brown Stem Rot, Anthracnose, Root Rot, Tip Rot & Black Rot: Spray with Sundomil 53g/16L Water.

**Insect Control/ Management:**
Slugs & Snails: Control by hand picking and use Snail bait.

Keep area clean.

*Scales:* Spray the affected vines with a mixture of Diazinon at 64ml/16L of Water with white oil.

**Harvest Yield/Food Value:**
Harvest 3 years after planting continues to increase in production for 4-5 years when it reaches peak production. With good management production can continue for 10 years.

**Yield:**
Improved Varieties : 300-600kg cured beans.

**Food Value:**
Food flavor

# Chapter 1.7 | Other Crops Grown in Fiji

# 1.7.1 Sugarcane
## *(Saccharum officinarum)*

**Cropping Season:**
All year round

**Recommended Varieties:**
- Nadiri
- Aiwa
- Beqa
- Galoa
- Kaba
- Mali
- Mana
- Ragna
- Vatu
- Waya
- Yasawa
- Kiuva
- LF91-1925
- Viwa
- Qamea

**Seed Rate:**
Varies from 5 to 8 tonnes depending on planting method. Use seed cane from a selected seed cane nursery. Use seed cane of 7-9 months from plant or first ratoon. Preferably from seed cane nursery.

**Planting Time:** Where soil is free draining, as on the hills, can plant during rainy months (December - March).

Flats - planting to be completed by May.
All replanting to be complete by end of October.

**Spacing:**
The spacing should be 1.37m (4.5 feet) but it also depends on the variety planted.

The bottom trough of the drill should be around 15 - 20cm below the ground level.

*Germination:* Within eleven days of planting and complete germination within 21 days. This depends on the quality of the seed cane, land preparation and prevailing weather conditions.

**Fertilizer/Manure:**
*Blend A:* Apply at planting (in drills) at 150kg-200kg/ha

*Blend B:* Apply at 8 weeks after planting at 700-800kg/ha

*Blend C:*
Apply on ratoon cane 2 to 4 weeks after harvest at 700-800kg/ha

Soil analysis should be done before fertilizer application.

**Weed Control/Management:**
*Velpar K4, Amine, Diuron* plus *E40:* Use of herbicide depends on the weed types.

**Disease Control/Management:**
Fiji Disease, Downey Mildew, Yellow Spot:

Use resistant varieties.

**Harvest/Yield/Food Value:**
After 12 to 14 months

Plant Cane (new crop) - > 65TCH
Ratoon Cane > 55 TCH
Crop Cycle 5 - 7 ratoons.

**Food Value:**
Carbohydrate

# 1.7.2 Tobacco
## *(Nicotiana tabacum)*

**Recommended Varieties:**
- NC 95
- G 28

**Yield:**
- 2000 Kg/ha (Green)
- 1500kg/ha (cured)

**Planting Density:**
- 1.2m between rows
- 1.5m within rows

**Planting Time:**
May – July

**Climatic Requirements:**
Rainfall 415mm. Dry cool season and leeward zone.

**Soil Requirements:**
Prefers sandy soils or sandy loams pH tolerance. Well drained soil Tobacco growing is generally restricted to low – rainfall areas.

**Method of Planting:**
Raised on nursery and then transplanted into the filed.

**Fertilizer Requirement:**
The objective is to provide the plant with adequate nutrition in its early stages of growth and then to limit then nitrogen supply as the crop approaches the flowering stags.
Nitrate of soda - 456kg/ha
NPK - 500-750kg/ha
Apply NPK on seed – bed at transplanting (May- June) Apply Nitrate of soda in June – July

**Plant Protection**
A)Weed Control: Use methyl bromide to fumigate soil and also soil sterilization for pathogens and micro-organism 0.6kg/12.5m

B) Disease; Fungal control – Apply Perenox during seed bed preparation 400g/100L $H_20$ or Benlate after transplanting 2g/4.5L of $H_20$.

**Time to Maturity:**
Mid June – Mid October

**Harvesting & Storage:**
Harvest by hand and store in dry shed.

# 1.7.3 Yasi (Sandalwood) *(Santalum yasi)*

**Recommended Varieties:**
- Santalum yasi
- Santalum album
- Santalum hybrid

**Seed Rate:**
400 seedlings per hectare

It is preferable to collect the ripe fruits from the tree for sowing.

**Spacing:**
Ideal spacing - 5m x 5m

Sandalwood grown on a wide range of soils, preferring loams and sandy loams. and favors high light requirement & well drained sites. It grows well in old garden sites and secondary forests, where there is a mixture of different plant species to act as hosts; pot host - Alternanthera sessilis; Field host - Citrus, Nokonoko, Vavai

**Fertilizer:**
Potting up seedlings: Potting Mix; 6 buckets top soil, 4 buckets compost, 1 bucket Sand and 250g NPK.

Seedling to be transplanted either before the seed cotyledon (2-leaf) or 4 leaf stages, taking care to minimize root disturbance and damage.

**Weed Control/ Management:**
Excess weed growth, especially of grasses, will crowd and shade out young sandalwood seedlings.

Periodic weeding on an as needed basis is recommended: weeding needed to be more frequent during the wet season.

As guide, weeding may be required 4 times in Year 1 & 2, twice in Year 3 & 4 and once afterwards.

All dead plants must be replanted within Year 1 of original planting.

**Disease Control/Management**
No serious disease of Yasi in Fiji.

**Insect Control / Management**
No serious pest outbreak.

**Harvest:**
**Yield/Food Value**
Yasi are ready for harvesting once they have reached an adequate size eg. 30-40cm diameter at ground level & developed substantial heartwood.

**Yield:** 25tonnes/ha

# 1.7.4 Voivoi
## *(Pandanus sp.)*

**Recommended Varieties:**
- Voivoi ni Viti
- Voivoi ni Valagi
- Voivoi sega nai coga

**Seed Rate:**
10,000 seedlings/ha

**Planting Time:**
Can be planted all year around.

**Spacing:**
Between rows : 1m
Plants within rows: 1m

**Fertilizer:**
Water the plants after transplanting and continue afterwards.

a) NPK - 13:13:21 200kg/ha basal application

Soil analysis should be done before fertilizer application.

**Weed Control/ Management:**
Hand -weeding is always recommended.

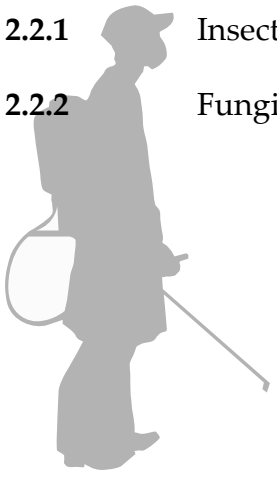
**Disease Control/Management:**
No serious disease of Voivoi in Fiji.

**Insect Control / Management:**
No serious outbreak of insects in Fiji.

**Harvest Yield/Food Value:**
Leaves are harvested after 4 months from planting depending on size of the plant

**Yield:**
640,000 leaves/ha/year

# Chapter 2 | Weeds, Insect and Disease Control



## 2.1 WEED CONTROL AND SPRAYER CALIBRATION

### 2.1.1 INTRODUCTION

Weed competition has its greatest effect during the first half of the life of an annual crop and the first one two year's life of a perennial crop. For a short lived annual crop (many vegetables) the first month after sowing is extremely important.

Therefore, it is very important that effective weed control take place during these periods, although the crop will additionally benefit from weed control throughout its life. In weakly competitive crops, such as onions, weed control is important throughout the growing season.

### 2.1.2 Types of Weeds and It's Chemical Control

The specific management measures adopted for any plant invasion will depend upon factors such as the landscape, the cost and availability of labour, the severity of the infestation and the presence of other weeds.

Prevention is the best form of invasive plants management. If prevention is no longer possible, it is best to treat the weed infestations when they are small to prevent them from establishing. Control is generally best applied to the least infested areas before dense infestations are tackled.

Consistent follow-up work is required for sustainable management.

| Weed | Herbicide and Rate | Remarks |
|---|---|---|
| **a. <u>Noxious Weeds</u>** | | |
| Wedelia (*Sphagneticola trilobata* ) | Escort (Metsulfuron methyl) at 0.3g/L water | Apply to actively growing plants before flowering. Spot spray application. |
| African tulip tree (*Spathodea campanulata*) | Glyphosate 360g/L at 1 part of glyphosate:1 part of water.<br><br>Tordon at 1 part of Tordon:1 part of water. | Apply immediately after ring-barking or cut and paint stump. |
| Giant sensitive plant (*Mimosa diplotricha*) | Diuron (150g/15L water) + Weed killer E80 (80% 2,4-D ester) (150mL/15L water) | Apply to actively growing plants before flowering. Spot spray application. |
| Guava (*Psidium guajava*) | Glyphosate 360g/L at 1 part of glyphosate:1 part of water.<br><br>Young plants, uproot. | Apply immediately after ring-barking or cut and paint stump. |
| Hibiscus burr (*Urena lobata*) | Weed killer E80 (80% 2,4-D ester) at 100mL/15L water or 133mL/20L water | Require rainfree period of c. 6 hrs. Avoid drift particularly near crops. Not effective when weed is stressed. |
| Johnson grass (*Sorghum halepense*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Diuron 200g/15L water.<br><br>Velpar K4 at 200g/15L water. | Spot spray on actively growing plants. |
| Itch grass (*Rottboellia exaltata*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Diuron 200g/15L water.<br><br>Velpar K4 at 200g/15L water. | Spot spray on actively growing plants. |

| Weed | Herbicide and Rate | Remarks |
|---|---|---|
| Lantana (*Lantana camara*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Tordon 7mL/L water | Apply to actively growing plants before flowering. Wet plants thoroughly. |
| Navua sedge (*Kyllinga polyphylla*) | MSMA 1.0 kg /ha.<br><br>Glyphosate 360g/L at 150mL/15L water. | Repeat spraying is necessary 3-5 weeks later. |
| Prickly solanum (*Solanum torvum*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Tobacco weed (*Elephantopus mollis*) | Glyphosate 360g/L at 150mL/15L water. | Spray young plants. Mature plants difficult to kill with herbicides. |
| Water hyacinth (*Eichhornia crassipes*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Weedkiller (E80) 270mL/100L water. | |
| **(b) Other Common Broad Leaf Weeds** | | |
| Blue Rat's Tail (*Stachytarpheta uriticifolia*) | Glyphosate 360g/L at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Noogoora burr (*Xanthium strumarium*) | Amine (2,4-D) 800mL/ha.<br><br>Escort (Metsulfuron methyl) 1.0g/10L water. | Apply to actively growing plants before flowering. |
| Commelina (*Commelina diffusa*) | Glyphosate 360g/L at 20mL/1L water. | Apply to actively growing plants. Spot spray application. |
| Dralakaka (*Vitex trifolia*) | Glyphosate 360g/L at 1 part of glyphosate:1 part of water.<br><br>Tordon at 1 part of Tordon:1 part of water. | Cut and paint stump. |
| Raintree (*Samanea saman*) | Glyphosate 360g/L at 1 part of glyphosate:1 part of water.<br><br>Victory Gold (50 g/litre picloram plus 100 g/litre triclopyr) at 1 part of herbicide: 1 part of water. | Apply immediately after ring-barking or cut and paint stump. |
| Willow Primrose (*Ludwigia octovalvis*) | Glyphosate 360g/L at 20mL/1L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Goat weed (*Ageratum conyzoides*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |

| Weed | Herbicide and Rate | Remarks |
|---|---|---|
| Kaumoce (*Senna tora*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Ellington curse (*Acacia farnesiana*) | Glyphosate 360g/L at 1 part of glyphosate:1 part of water.<br><br>Tordon at 1 part of Tordon:1 part of water. | Apply immediately after ring-barking or cut and paint stump. |
| Jerusalem thorn (*Acacia consinna*) | Glyphosate 360g/L at 1 part of glyphosate: 2 parts of water. | Cut and paint stump. |
| Mile – a – minute (*Mikania micrantha*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Sensitive plant (*Mimosa pudica*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Tar weed (*Cuphea carthagenensis*) | Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Glyphosate 360g/L at 150mL/15L water.<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Broomweed (*Sida acuta*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Thick head (*Crassocephalum crepidiodes*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before flowering. Spot spray application. |
| Wadamu (*Merremia peltata*) | Glyphosate 360g/L at 150mL/15L water. | Apply herbicide immediately after slashing. |
| Wild Yaqona (*Piper aduncum*) | Glyphosate 360g/L at 150mL/15L water. | Repeat spraying is necessary 4 weeks later. |
| Yaqona ni Tonga (*Piper auritum*) | Glyphosate 360g/L at 150mL/15L water. | Repeat spraying is necessary 4 weeks later. |
| Honolulu rose (*Clerodendrum chinense*) | Escort (Metsulfuron methyl) at 0.3g/L water | Apply to actively growing plants. Spot spray application. |
| Fireworks (*Clerodendrum quadriloculare*) | Glyphosate 360g/L at 1 part of glyphosate:1 part of water. | Cut and paint stump. |

| Weed | Herbicide and Rate | Remarks |
|---|---|---|
| Button weed (*Spermacoce latifolia*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants |
| Morning glory (*Ipomoea indica/ Ipomoea cairica*) | Glyphosate 360g/L at 20mL/10L water.<br><br>Escort (Metsulfuron methyl) 1.5g/10L water. | Spot spraying for seedling control. |
| Salvinia (*Salvinia molesta*) | Glyphosate 360g/L at 10mL/10L water. | Apply to actively growing plants. Overall spray application. |
| Pickerel Weed (*Pontederia cordata*) | MCPA at up to 1L/ha.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Glyphosate 360g/L at 150mL/15L water. | Apply to actively growing plants. Spot spray application. |
| Heartleaf false pickerelweed (*Monochoria vaginalis*) | MCPA at up to 1L/ha.<br><br>Weed killer E80 (80% 2,4-D ester) (150mL/15L water).<br><br>Glyphosate 360g/L at 150mL/15L water. | Apply to actively growing plants. Spot spray application. |
| **c) Other Common Grass Weeds** | | |
| Guinea grass (*Panicum maximum*) | Diuron 200g/15L water.<br><br>Velpar K4 200g/15L water.<br><br>Glyphosate 360g/L at 150mL/15L water.<br><br>Paraquat at 150mL/15L water. | Apply to actively growing plants before seedhead stage. |
| Giant reed (*Arundo donax*) | 1 part Glyphosate 360g/L to 50 parts water.<br><br>1 part Glyphosate 360g/L to 1.5 parts of water. | Spot spray. Spray regrowth.<br><br>Cut & paint stump. |
| Bristly foxtail grass (*Setaria barbata*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Paraquat at 150mL/15L water.<br><br>Diuron 200g/15L water.<br><br>Velpar K4 200g/15L water. | Apply to actively growing plants before seedhead stage. |
| Russel river grass (*Paspalum paniculatum*) | Glyphosate 360g/L at 150mL/15L water.<br><br>Paraquat at 150mL/15L water.<br><br>Diuron 200g/15L water.<br><br>Velpar K4 200g/L water. | Apply to actively growing plants before seedhead stage. |

| Weed | Herbicide and Rate | Remarks |
|---|---|---|
| Elephant grass (*Pennisetum purpureum*) | Diuron 200g/15L water.<br>Velpar K4 200g/15L water.<br>Glyphosate 360g/L at 150mL/15L water.<br>Paraquat at 150mL/15L water. | Apply to actively growing plants before seedhead stage. |
| Crow's foot grass<br>(*Eleusine indica*) | Diuron 200g/15L water.<br>Velpar K4 200g/15L water.<br>Glyphosate 360g/L at 150mL/15L water.<br>Paraquat at 150mL/15L water. | Apply to actively growing plants before seedhead stage. |
| Jungle rice (*Echinochloa colona*) | Diuron 200g/15L water.<br>Velpar K4 200g/15L water.<br>Glyphosate 360g/L at 150mL/15L water.<br>Paraquat at 150mL/15L water. | Apply to actively growing plants before seedhead stage. |
| Para grass (*Urochloa mutica*) | Diuron 200g/15L water.<br>Velpar K4 200g/15L water.<br>Glyphosate 360g/L at 150mL/15L water.<br>Paraquat at 150mL/15L water. | Apply to actively growing plants before seedhead stage. |
| Mission Grass (*Pennisetum polystachion*) | Glyphosate 360g/L at 150mL/15L water.<br>Diuron 200g/15L water.<br>Velpar K4 200g/15L water.<br>Paraquat at 150mL/15L water. | Apply to actively growing plants before seedhead stage. |

Note: Read the label carefully before use. Always use the herbicide in accordance with the directions on the label.

### 2.1.3 CHOICE OF METHODS

There are three main types of in-crop weed control used in Fiji:

(1) Hand weeding/slashing with knives
(2) Inter- row cultivation in crops using animals or tractors
(3) The use of herbicides.
(4) Intermittent Irrigation.

The choice of the types of weed control used is the decision of the farmer or person responsible for the operation. It has been consistently shown that chemical weed control is the most economical in crops provided the labour involved in hand-weeding or inter-row cultivation is costed at normal wage rates. When weeds are controlled by herbicides, labour can be put to alternative uses such as growing additional crops. However chemicals are expensive, money may not be readily available for their mixing and application is an involved process. When there is abundance of family labour it is advisable that hand weeding is practiced.

### 2.1.4 STEPS FOR THE CORRECT APPLICATION OF HERBICIDES

1. Read the label and other advisory material, such as the booklets available from MPI and the agents who sell the chemicals. For example to apply at 2 – 3 leave stage of the weeds recommended.
2. Carry out the operation at the recommended time of spray application in relation to growth stage of the crop and weeds.
3. Spray only in calm weather or in a slight breeze. Do not spray if it is likely to rain within a few hours.
4. Calibrate the sprayer properly.
5. Sometimes it is necessary to calculate the quantity of product needed from the rate for active ingredient given in advisory literature or the nature.
6. Measure out and mix the correct quantities of herbicides and water. Follow the mixing. Instructions are on the label attached to the container of the chemical.
7. Apply the herbicides evenly by maintaining a steady height of the spray nozzle, a steady height walking pace and an even pressure.
8. Clean the sprayer thoroughly after use.
9. Be aware personal safety i.e. protective clothing, gloves and goggles should be worn if recommended on the label. It will be safer if precaution is taken at all times. Also wear respirators.

### 2.1.5 WEED CONTROL RECOMMENDATIONS

Unless otherwise stated, the rates given in this chapter are active ingredient and have to be converted by the user into product rates. Where there is only one product registered that contains the active ingredient recommended, the rate of the product is given in brackets. If, in the future, more products are registered with those active ingredients, the recommendation should not be taken as brand preference. These recommendations are not meant to imply that other herbicides are necessarily unsuitable for a particular purpose.

**A. <u>Weed control in Non-Crop Situations</u>**

Drain, bunds, roadsides etc. - for the control of grasses like para-grass, mission grass and broadleaf weeds like willow primrose, mile-a-minute, tar weed etc apply glyphosate (100mL/10L water). Escort (Metsulfuron methyl) at 0.3g/L water is recommended for controlling wedelia (*Sphagneticola trilobata*).

**B. <u>Weed control in Crops</u>**

| Crop | Recommended herbicides |
|---|---|
| Banana | Paraquat, Glyphosate, Atrazine, |
| Cassava | Paraquat, Glyphosate, Diuron |
| Citrus | Diuron, Atrazine, Paraquat, Glyphosate, MSMA. |
| Cocoa and Coffee | Paraquat, Glyphosate, Diuron. |
| Coconut | Ring weeding: Paraquat, Glyposate, MSMA<br>diuron.<br>Do not use the herbicide recommended within 1m from palms |
| Dalo | Paraquat, Glyphosate |

| | |
|---|---|
| Ginger | Diuron, Atrazine, Paraquat, Glyphosate. |
| Maize | Atrazine |
| Passion fruit | Paraquat , Glyphosate. |
| Pineapple | Diuron, Atrazine, Paraquat,<br><br>Glyphosate, MSMA. |
| Pulse Crops (Cowpea, Groundnut, mungbean, Pigeon Pea,Urd) | Hoeing. No herbicide recommended |
| Rice : Wetland & Dryland | Propal, M.C.P.A., 2,4-D |
| Sorghum | Atrazine |
| Yam | Diuron, Atrazine, Paraquat, Glyphosate. |

**Herbicide Recommendations**

**(a.i. - active ingredients)**

***Atrazine***

3.0 kg/ha (various products, 80% a.i., 3. 7 kg/ha). Apply after planting the crop and before the emergence of the weeds, preferably to moist soil. The herbicide controls most annual grasses and broadleaf weeds. It does not control nutsedge. Atrazine remains active in the soil for weeks.

***Glyphosate***

Mix clean water and herbicide at a rate of 2 parts water to 1 part glyphosate for broadleaf weed through a Wick wiper. A diluted mixture of 4 to 1 can be used for unwanted grass type vegetation. Spot spraying using knapsack sprayer could also be used but avoid spray drift to crops or any desirable vegetation.

For controlling African tulip trees, use 1 part glyphosate to 1 part water mix in a plastic bottle with a small hole on the lid, immediately spray on about 2-3cm deep ringbarked area.

***MCPA***

Sown rice: apply 5 – 7 weeks after sowing. Transplanted: apply 3 – 4 weeks after transplanting. Application must be before the boot stage of rice. Avoid spray drift to any desirable vegetation. For knapsack, spot treatment applications, mix 165 mL of product in 10 L water. Spray to wet all foliage thoroughly. MCPA herbicide controls broadleaf weeds and young sedges.

***Paraquat***

Paraquat 250g/L (0.6 – 1.2L/ha) use as a directed spray and with a spray shield in annual and young plantation crops. Use the higher rates when the weeds are old and for dense weed stands. Do not spray plants which are waterlogged, under stress of any kind or covered with soil or dust. Do not sow or cultivate for 1 hour after spraying but operations should commence within 7 days. Control most annual weeds .

*Diuron*

Pineapple: Apply as a blanket spray after planting and before weed emergence. Ratoon Crops: Apply immediately prior to first rains on weed free soil. Rate: 4kg/ha. Apply up to 4000 L water/ha. **DO NOT apply more than 8 kg/ha before fruit differentiation or flower bud formation.** Follow-up sprays, if necessary, should be made at the lower rate (2kg/ha).

Cassava: Apply as a pre-emergent (2kg/ha).

*Propal*

It is a post emergence, contact, and selective herbicide that controls many annual grasses. To be effective, the weed foliage must absorb Propal. Starting from the day of spraying, a paddy must be drained for about one week to expose weeds to the herbicide and ensure a contact. The rate of application of Propal ranges from 3 kg a.i./ha to 4 kg a.i./ha. The herbicide is applied 10 to 20 DAT, or 10 to 20 days after sowing pre germinated seeds. To avoid crop damage, propal should not be applied within two weeks after applying carbamates and organophosphate insecticides.

*Basagran PL2*
For controlling all weeds in both dryland and wetland rice, apply Basagran PL2 at 4L/ha at 3-4 leaf stage.

*2,4-D or MCPA*
0.5-1.0kg ai/ha in water seeded-irrigated rice apply as post-emergence, lower water level to expose foliage of small weeds. Do not allow soil to dry. Under broadcast/drill seeded rice or dry-sown irrigated rice, apply 0.5-1.0kg ai/ha 3-4weeks after seeding to control broad-leaf weeds and sedges.

**C. <u>Weed control in Vegetable Crops</u>**
Targa (Quizalofop-p-ethyl, 99.5g/L) is a selective herbicide used for controlling annual and perennial grass weeds in broadleaf crops at 125mL/100L water.

For crops grown on wide row spacing such as potatoes, tomatoes, cucumbers and cabbages; Paraquat and Glyphosate can be used to control weeds between the rows and between crop plants within the row when the plants are small. Use spray shield to avoid spray drift. However, glyphosate should not be used prior to transplanting tomato seedlings.

**D. <u>Herbicides Recommended for Minimum Tillage or No Tillage Crop Growing</u>**
Herbicides can be used to assist or replace the plough. Expert advice should be sought before growing crops such as rice, maize or legumes in this way.

The following herbicide recommendations are given as suggestions. They are derived from work in tropical countries but they have to be modified to suit each local situation.

**i) *Glyphosate***

Glyphosate 360g/L. For knapsack sprayer, use 10mL/L water. Controls annual and perennial weeds which includes most grasses, sedges and broadleaf weeds. Best result on actively growing plants. For difficult to kill weeds such as nut sedge, after first application, allow maximum re-emergence to occur (normally in 6-8 weeks) it is essential to make a second application. Higher rate 13mL/L is recommended for paragrass at actively growing stage.

### ii) *Paraquat*

Paraquat. For knapsack sprayer, use 10mL/L water. Controls most annual grasses, sedges and broadleaf weeds.

**Note**

The following spray programme has been found to be effective in many situations:

1) Glyphosate 1.0kg/ha (Glyphosate 360g/L) up to 3.0 L/ha), 8-12 days before planting.

Followed by:

2) Paraquat 0.4kg/ha (Gramaxone 2.0L/ha) prior to or just after planting.

## E. Weed control in Sugarcane

**Table 1. Pre-emergence treatments of weeds in planted crop**

| Herbicide | Rate / 15L knapsack | Weeds |
|---|---|---|
| Atrazine | 200g | Broadleaf |
| Diuron 900 | 250g | Grass |
| Karmex | 276g | Grass |
| Diuron 900 + Atrazine | 200g + 200g | Broadleaf + grass |
| Karmex + Atrazine | 225g + 225g | Broadleaf + grass |

**Table 2. Post-emergence treatments of weeds in planted crop**

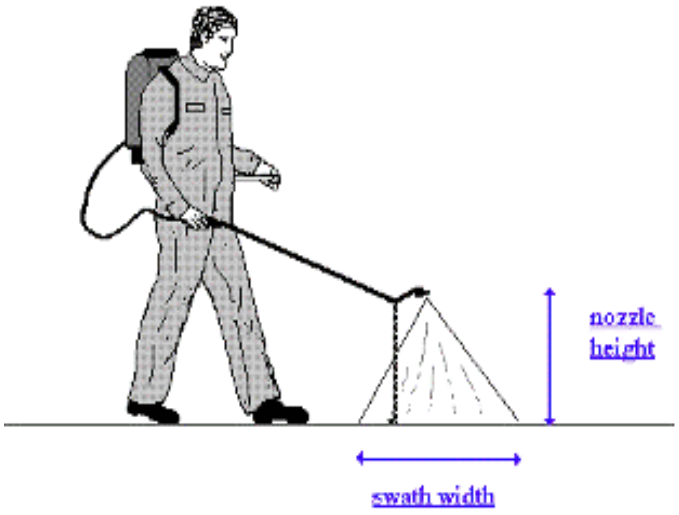
| Herbicide | Rate / 15L knapsack | Weeds |
|---|---|---|
| 2,4-D Ester (E80) | 150mL | Broadleaf |
| Diuron 900 or Karmex | 200g | Grass |
| Diuron 900 + Amine 720 | 150g + 150mL | Broadleaf + grass |
| Karmex + Amine 720 | 150g + 150mL | Broadleaf + grass |
| Atrazine + 2,4-D Ester (E80) | 150g + 150mL | Broadleaf + creeper |
| Amine 720 | 150mL | Broadleaf + creeper |
| 2,4-D Ester (E80) | 100mL | Broadleaf + creeper |

**Table 3. Pre-emergence to early post-emergence treatments of weeds in ratoon crop**

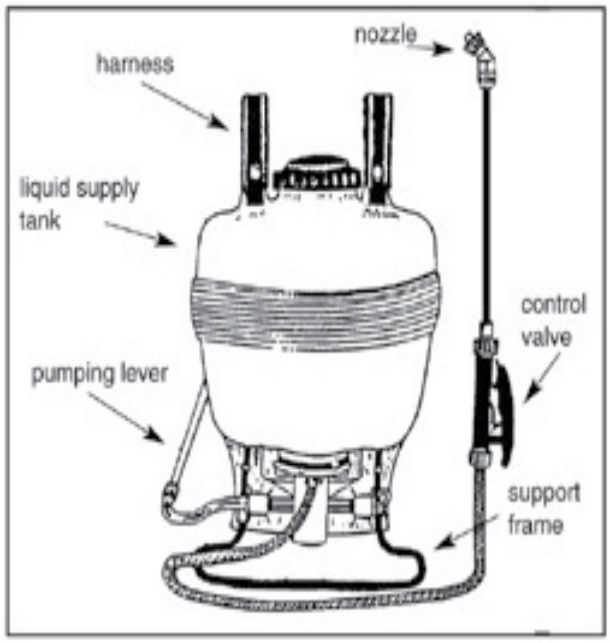
| Herbicide | Rate / 15L knapsack | Weeds |
|---|---|---|
| Diuron + 2,4-D Ester (E80) | 150g + 100mL | Broadleaf + grass + creeper |
| Velpar K4 | 200g | |
| Atrazine + 2,4-D Ester (E80) | 150g + 150mL | |

*Note:* use 20-25mL sticker / knapsack to improve effectiveness of the herbicide. For dense, tall growing vegetation (greater than 30cm tall), the area will need to be slashed down to 10-15 cm and allow to regrow before spraying. An alternative is to spray glyphosate 6-8 weeks before planting and allow the vegetation to break down.

## 2.1.6 ACURATE SPRAY COVERAGE




It is very difficult to get accurate spray coverage in many situations. A weed problem will occur in areas that are missed spraying, while money is wasted where overlapping occur. Also with overlapping, some herbicides may present a danger to the crop or pasture. If available, the use of a marker dye in the spray overcomes the problem.




Although less accurate, another method involves the use of pegs, spaced width of the spray band, at both ends of the field to be sprayed and walking in a straight line between opposite pegs. This method can be made more accurate on relatively flat land by using strings between opposite pegs and holding the spray nozzle over the top of the string.

## 2.1.7 SPRAYER CALIBRATION

The calibration of sprayers is a difficult exercise if a person is not used to the steps involved. Correct calibration of the sprayer is one of the most important tasks in pesticide application. For this reason, users should become thoroughly familiar with the process for accurate sprayer calibration.

### Steps in calibrating knapsack sprayers

| | |
|---|---|
| **1. Prepare Sprayer** | Rinse and clean sprayer, strainer nozzle and hose.<br><br>Fill sprayer with clean water<br><br>Apply pressure with cut –off valve in closed position and check for leaks. Then flush pump, hoses and lance with clean water first with nozzle removed and next wit nozzle replaced in lance. |
| **2. Determine nozzle discharge** | Fill the sprayer with clean water and pump for pressure, while keeping it on the ground.<br><br>Place the nozzle in a bucket or jar and spray water into the container for one minute period. Shut off the valve exactly at the end of one minute. Measure the volume of water in the container.<br><br>Repeat this calibration spraying three times to obtain the average nozzle discharges per minute, which should be used in subsequent calculations. |

| | |
|---|---|
| **3. Determine walking Speed of Spray man** | Do this in the filed planted with the crops that will be sprayed.<br>Carry the sprayer on the back and operate by pumping while direction lance and nozzle within a spray swath. Walk exactly one minute, while someone else is reading the time on a watch. Walk at a normal and constant speed.<br><br>Mark stopping point with another stake and measure the distance between the first and second stake in meters.<br><br>Repeat this action three times to obtain the average walking speed. |
| 4. Determine the width of the swath | Measure the width of the spray swath in meters, while keeping the distance between nozzle and ground level constant. The width of the swath can clearly be seen on an asphalt road surface or on a dry path. |
| 5. Calculate area sprayed in one minute: | Area sprayed per minute ($m^2$/min = width of swath (m) x walking speed (m/ minute) |
| 6. Calculate spray volume per unit area | Volume of spray per hectare (liters/ha) = Nozzle discharge (L/min x hectare ($m^2$)<br>Area sprayed in one minute ($m^2$/min) |

Example: if the:

- Nozzle discharge rate = 0.5L/min
- Area sprayed in 1 min = 25$m^2$
- Then the spray volume per hectare would be:

= 0.5L/min x 10,000$m^2$

25$m^2$/min (Note: 1 ha = 10,000$m^2$)

= **200L**

7. Calculate number of sprayer loads per unit area

No. of loads per hectare = Spray volume/hectare
Tank capacity of the sprayer

Example: With the data above the spray volume per hectare is 200L. If the sprayer has a tank capacity of 20L, we would require 10 sprayer loads to cover 1 hectare.

No. of loads per hectare = 200L / 20L

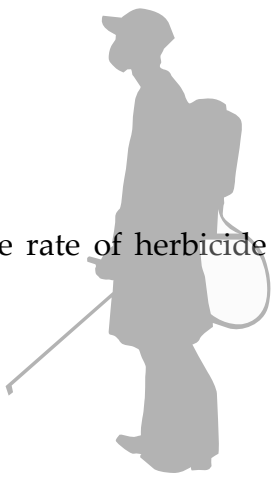
= 10 sprayer loads.

**8. Determine amount of herbicide added to each knapsack**

Amount per knapsack = Amount per ha
No. of sprayer loads per ha

Example: If 10 sprayer loads are required per ha. (as above) and the rate of herbicide product is 3 L/ha, then the rate per sprayer load is:

Amount per knapsack = 3L / 10 = 300mL



**9. If the recommendations used are given in active ingredients (a.i) this first has to be converted to product**

Amount of product = 100 / % a.i. x rate of a.i

= kg/ha or L /ha

Example: rate of active ingredient / ha = 1.5kg
% of a.i of the product = 50%
Therefore, the rate of product per ha = 100/50 x 1.5 = 3 kg or L
(depending on whether it is a liquid or powder formulation.

### 2.1.8 FORMULATION COMPATIBILITY

Occasionally it may be desirable to apply two herbicides at the same times, as a mixture. It is usually satisfactory to mix two different herbicides with the same formulation, for example, two wettable powders or two emulsifier concentrates. However there may be problems and mixing should always be tried on a small quantity first before making a large batch of spray solutions. Problems may arise when two different formulations are mixed, for example, a wettable powder with an emulsifiable concentrate. Generally, this practice is not recommended, but if it is necessary remembers to try it on a small quantity first.

### 2.1.9 CLEANING SPRAYER


The sprayer should be cleaned thoroughly after use. If this is not done some corrosive chemicals may damage the sprayer and permanently contaminate it. Cleaning is especially important after use of Paraquat. First rinse with clean water, then wash thoroughly with detergent or soap and water then finally rinse with water until no trace of detergent is left. At each stage, pump out some of the liquid through the hose and nozzles. If a sprayer has been used to spray pesticides mixed with oil instead of water. Firstly rinse with gasoline or kerosene before using the detergent.

### 2.1.10 ULTRA LOW VOLUME (ULV) SPRAYING

Ultra Low Volume (ULV) equipment is designed to produce very small droplets, thus ensuring even coverage with low volumes. The equipment is based on aerosol, mist-blower, exhaust gas sprayers or rotary nozzle techniques. Ultra Low Volume, spraying generally refers to using a spray volume of less than 50 liters per hectare, or 5 gallons per acre. A major benefit of ULV application is high work rate (i.e. hectares can be treated in one day). It is a good option considering the following:

- large area of land to treat

- rapid response required
- little or no water for making pesticide tank mixtures
- logistical problems for supplies
- difficult terrain: poor access to target site

However, its limitations may include:

- drift hazards,
- coverage may not be thorough,
- high concentrates present safety hazards,
- use of concentrated pesticides may increase chance of dosage errors,
- few pesticides are labeled for ULV.

### 2.1.11 THE SPRAY SHIELD

The spray shield is a device for protecting crop plants from a herbicide that is toxic to them. It is attached just above the nozzle of a knapsack sprayer. It is particularly useful for spraying paraquat (Gramaxone) in annual crops and in young plantation crops.

When spraying around a crop ensure that the bottom of the shield is almost touching the ground. Then spray the herbicide either moving away from the base of the plant or around the plant, making sure it is fully protected by the shield.

### 2.1.12 THE WICK WIPER

The wick wiper is used for the application of glyphosate. The recommended dilution rate is one of product to two of water. The implement works by wiping liquid onto the weeds. Because glyphosate moves very easily within the plant, complete coverage of each plant is unnecessary. The wick wiper has two advantages. Firstly, it uses less herbicide then normal spraying. Secondly, it is much safer to use in crops. Because glyphosate moves very easily in the plants, it is most important that it does not come in contact with the crop. The wick wiper controls application even better than the spray shield and careful weeding around crop plants can be done with relative safety.

### 2.1.13 COMMON TECHNICAL TERMS

| | | |
|---|---|---|
| Acid Equivalent | - | The amount of active ingredient expressed in terms of the parent acid. |
| Active Ingredient(s) | - | The weed- Killing materials(s) present in a formulation. |
| Inert Ingredients | - | The materials present in a formulation which do not have killing properties. |
| Formulation | - | The herbicide preparation that is sold to the user, consisting of active ingredient(s) plus inert ingredients |

<u>Types of formulation</u> – Important Characteristics

**1) Emulsifiable Concentrate**
The ingredients are dissolved in an organic solvent liquid. When mixed with water to form the spray liquid, the formulation forms a suspension of very small droplets within the water.

**2) Flowables**
The liquid or solid ingredients are suspended in a liquid to form a thick fluid. The formulation either dissolved or is suspended in small particles or droplets in the water added to from the spray liquid.

**3) Soluble Powders**
Completely dissolve in the water added to from the spray solution.

**4) Solutions**
The ingredients are completely dissolved in water (aqueous concentrates) or (oil concentrates).These are then diluted by water or oil to form the spraying liquid.

**5) Wettable Powders**
Form a suspension of small particles in the water added make up the spraying liquid.

Surfactants – Materials used in formulation to give, variously, the characteristics of forming an emulsion, the ability to disperse when diluted to form the spray liquid, the ability to spread on plant surface, the ability to wet plant surfaces.

**Wetting Agent** – A material which, when added to the spraying liquid, increased its ability to wet plants.

**Herbicide** – A chemical which can kill or inhibit the growth of a plant. The term can be used either to denote active ingredient or a product containing a herbicide's active ingredient.

**Types of Herbicides**

| | | |
|---|---|---|
| 1) **Contact** | – | Affects only the parts of the plants which it falls upon |
| 2) **Non Selective** | – | Kills or affects all plants, sometimes related to type of application. |
| 3) **Residual** | – | Persists in the soil, killing weeds as they germinate |
| 4) **Selective** | – | Capable of killing or inhibiting growth of particular plants while not harming others. |
| 5) **Soil sterilant** | – | When applied to the soil, prevents the establishment of vegetation for a relatively long time. |
| 6) **Translocated** | – | After penetration the herbicide is capable of movement within the plant. |

## 2.1.14 TYPES OF APPLICATION

| | | | |
|---|---|---|---|
| 1. | **Band** | – | Where a herbicide is applied to bands and not the entire area. |
| 2. | **Basal bark** | – | A method of killing trees or brush in which the chemical is applied (by sprayer or paint brush) to a bark encircling the base 30 – 60cm of the stem or trunk. |
| 3. | **Directed** | – | The herbicide is directed towards the ground or weeds to minimize contact with the crop. |
| 4. | **Frill** | – | A series of overlapping cuts made into the bark of a tree, into which herbicide is applied. |
| 5. | **Overall** | – | The spray is applied uniformly over the whole area. |

## 2.2 INSECT PEST & DISEASE CONTROL

Management of insect pests and diseases are an essential component in any agricultural farming enterprise. Pests are managed to prevent crop losses in both field and in post harvested crops.

### 2.2.1 INSECTICIDES RECOMMENDED FOR CROPS

| Insecticide | Active Ingredients | Control | Rates |
|---|---|---|---|
| Ag-Chem BT<br><br>Biological Insecticide | *Bacillus thuringiensis*, Bt<br><br>23.7% w/v | A highly selective insecticide<br><br>for use against caterpillars (larvae) of Lepidopterous insects i.e., DBM (Diamond back moth), armyworms, tomato fruit worm & pod worm. | 8g/16L Water<br><br>10g/20L Water<br><br>Withholding period Nil |
| Match Insecticide | Lufenuron 500g/L | An insect growth inhibitor for the control of DBM in cabbages | 12ml/20L Water<br><br>Withholding period-14 days |
| Prevathon | Rynaxypyr 5%<br><br>(51.5g/L) chloran-tranillprole in the form of suspension concentrate | DBM, LCM (large cabbage moth), pod borer, armyworms, cluster caterpillar, semi looper, centre grubs, cut worm, leaf roller, leaf miners | 10-15 mL /10L of water<br><br>Withholding period 7 days |
| Multi-Guard 1.8EC Insecticide | Abamectin (18g/L; 1.8%) EC | For control of whiteflies, DBM, leaf miner, citrus rust mites, two-spotted spider mites and beetle on a range of fruits, vegetables and ornamental plants. | 8mL-10mL/16L water<br><br>Holding Period- 7 days |
| Suncloprid 20 SL<br><br>Farmers Cloprid<br>Confidor Garden Insecticide<br><br>Confidor | ImidaCloprid 20% w/v<br><br>ImidaCloprid 20% w/v<br>ImidaCloprid 20% w/v<br>ImidaCloprid 20% w/v | A systemic insecticide for the control of sucking insects like aphids, leafhoppers, thrips, whitefly, mealy bugs and scale insects in vegetables, citrus ornamentals, rice, fruit tree and control taro beetle.<br><br>For taro beetle treatment, apply once at planting and after 3 months later at 100mL/ plant. | Vegetables- 25-50mL/100L water Holding Period- 10days<br><br>Dalo - 25mL/10L water |
| Hextar Carbacide 85 | Carbaryl 800g/Kg in the form of a wet-table powder | For control of armyworm, stem borer, leaf rollers and aphids on a range of vegetables crops and ornamental plants. | 18g/10L of water<br><br>Holding period- 7days |
| Zagro Turbo 2.5 EC<br>Super-Guard 2.8EC Insecticide<br><br>Farmthrin 2.5EC<br><br>Suncis 25 EC | Deltamethrin 2.5% w/w<br>Deltamethrin 2.8% w/w (28g/L)<br><br>Deltamethrin 2.5% w/w<br><br>Deltamethrin 2.8% w/w | Pyrethroids, contact insecticides for the control of caterpillar, beetles, thrips, white butterfly, on a broad range of fruits and vegetables and ornamental plants. It is fast acting, stable and has moderate persistence on plants. | Knapsack: 8mL/16L 10mL / 20L<br><br>Holding period- 7 days |

| | | | |
|---|---|---|---|
| Diazinon 20<br><br>Hextar Mapa Diazinon 60 | Diazinon 200g/L<br><br>Diazinon 55% | For control of aphids, mites, leaf miners, leaf hoppers, flea beetles, leaf miners, earworm in rice, citrus, vegetables, tomatoes & watermelon. | Knapsack : 60mL/20L<br><br>Holding period- 14 days |
| Malathion 50 EC (Maldison).<br><br>Malathion 840 | 500g/L w/v maldison<br><br>Malathion 84% w/w | Organophosphate contact insecticide.<br>For control of leaf hoppers, aphids, thrips, whitefly, mealy bugs and spider mites. | Knapsack : 40mL/14L<br><br>17mL/10L water<br>Holding period- 7 days |
| Chlorpyrifos 500 EC | 500g/L Chlorpyrifos (anti-cholinesterase compound) | For control of wide range of insects pests include wireworm, white fly, mealy bugs, crickets, cutworm on fruits, vegetables, cereals, pasture and turf. | 1mL/ L of water<br><br>Holding period- 7 days |
| Steward 150 SC | Indoxacarb 150g/L | For control of caterpillars in cabbage, DBM, LCM, cluster caterpillar, semi looper, centre grubs, leaf miners, cut worms and web worms. | Knapsack: 5mL/10L water.<br>Mist-blower: 2.5mL/L water<br><br>Holding period 7 days |
| Bifenthrin 8 SC | Bifenthrin 80g/L | A systemic pyrethroid insecticide with a broad spectrum activity which has a rapid knockdown and a long residual action.<br>Controls caterpillar, aphids, leaf miners, whitefly, thrips, mites and taro beetle.<br>For taro beetle, start treatment once at planting and after 3 months later at 100mL/ plant. | Knapsack:<br>15-20mL/16L<br>20-25mL/20L<br>Holding period- 3 days<br><br>Taro beetle<br>40mL /16L<br>50mL /20L |
| Sundothrin 25 EC | Permethrin 250g/L (25%) as Emulsifiable concentrate | A synthetic contact pyrethroid insecticide.<br><br>For control of cluster caterpillar, cabbage aphids, armyworms and bean pod borer. | Knapsack : 17-22mL/16L<br>21-26mL/20L<br>Spray when insects first appear and repeat when necessary.<br><br>Holding period, 3-7 days |
| Sunthene 75 SP<br><br>Royalthene<br><br>Acephate 90SP | Acephate (75% w/v)<br><br>Acephate 75% w/v<br><br>Acephate 90%w/v | A broad spectrum systemic insecticide for the control of wide range of chewing and sucking insects, most caterpillars, aphids, thrips, leaf miner, leafhoppers, cutworm on vegetable crops, citrus, avocados, ornamentals, tobacco and rice. | Knapsack:<br>12g/16L water<br>15g/20L water<br><br>Holding period 7 days<br>7-10g/15L water<br><br>Holding period 7 days |

## 2.2.2 FUNGICIDES RECOMMENDED FOR CROPS

| Fungicide | AI | Control | Rates |
|---|---|---|---|
| Benomyl | Methyl 1-(butylcarbamoyl) benzimidazol-2-ylcarbamate. | Recommended for Chilli anthracnose.<br><br>Powdery mildew in cucurbits<br><br>Tomato leaf mould<br><br>Avocado/Mano anthracnose | 15g/15L water, spray at early flowering stage as a protectant fungicide.<br>5g/10L water<br><br>5g/10L water Withholding period –3 days<br><br>50g/100L water, apply 2 sprays at monthly intervals during flowering. Withholding period – 14 days |
| Kocide 2000 DS | Copper (Copper hydroxide) | Chilli Anthracnose<br><br>Downy mildew in Brassicas, cucurbits, lettuce<br><br>Late blight, Early blight, Bacterial spot of tomatoes | 15-20g/15L water, spray weekly before and after harvest.<br><br>15-20g/15L water. Begin application after transplants are set in the field. Repeat at 10-14 day intervals.<br><br>15-20g/15L water. Apply at 7-10day intervals. Ensure full cover spray of upper and lower leaves. |
| Copper Oxychloride 84 | Copper Oxychloride 84% w/w | For the control of fungal & bacterial diseases in many fruits & vegetable crops. Anthracnose (long bean)<br><br>Cocoa black pod | 18g/10L water<br><br>33g/10L water |
| Agent 500 SC | Chorothalonil 40% w/w | Broad-spectrum fungicides for the control of Chilli anthracnose, chilli fruitrot, tomato anthracnose, cabbage downy mildew, leaf spot & root rot. | 15mL/10L water<br><br>Withholding period – 7 days |
| Mancozeb 80 | Mancozeb 80% w/w | A protectant fungicide for control of fungal diseases in agricultural crops. | 20g/10L water<br><br>Withholding period – 7 days for other crops & 14 days for chilli. |

# Chapter 3 | Livestock Performance in Fiji

## 3.1 CHARACTERISTICS OF FARM ANIMALS
### General Information

**Table 3.1.1 Normal & Range of Temperature, Pulse & Respiration.**

| | Normal Temperature (Degree Celsius - $^0$C) | Pulse beats/min | Respiration Breaths/ min |
|---|---|---|---|
| Cattle | 38.5$^0$ C | 40-80 beats/min | 27-40 |
| Pig | 39$^0$ C | 60-90 beats/min | 8-18 |
| Goat | 39.5$^0$C | 70-130 beats/min | 19 |
| Sheep | 39$^0$ C | 70-130 beats/min | 12-20 |
| Horse | 38$^0$ C | 35-40 beats/min | 11-14 |
| Chicken | 42$^0$ C | To be verified | To be verified |
| Duck | 42.1$^0$ C | To be verified | To be verified |

*(Source : The Paravet Training Manual - SPC, 2006)*

Temperature can be taken with a common clinical thermometer in the rectum for one and a half minute. A high temperature in a resting condition generally indicate ill health. The animal body has a number of ways to regulate its body temperature: Hair, wool, a thick layer of fat and burning food ( sometimes in walking, running, shivering) to keep the body warm; Sweating, panting, wallowing in mud, and lying in the shade to cool the body.

On the other hand, the pulse rate is a measure of heart beats per minute and will be high in young animals and animals that have been running or working. To check the animal's pulse rate; one should feel for it with the first two (2) fingers of the hand as follows:

**Sheep & Goats**: You can feel the pulse on the inside of the top of the back leg or inside the top of the foreleg (front leg).

**Cattle** : Take the pulse rate on the underside of the base of the tail.
**Horse** : Take the pulse rate on inside the top of the foreleg (front leg).
**Respiration :** A healthy animal breathes smoothly and regularly when it is at rest. If an animal has rapid breathing or breathing problems/difficulties it should be examined. Movement and hot weather will increase breathing rates, so rapid breathing is not necessarily a sign of health problem. Coughing and sneezing are also signs of health problems.

**Table 3.1.2 Table of Puberty, Oestrus & Gestation**

| | Puberty (months) | Cycle (days) | Oestrus - duration | Return Heat After Birth | Gestation (days) |
|---|---|---|---|---|---|
| Cow | 10-20 months | 21 days | 10-18 hours | 40-60 days | 280 days |
| Goat | 6-12 months | 17 days | 1-3 days | 30-40 days | 150 days |
| Sheep | 6-12 months | 17 days | 1-2 days | 30-40 days | 150 days |
| Horse | 12-18 months | 14-16 days | 7 days | 9-14 days | 340 days |
| Pig | 5 months | 21 days | 8-36 hours | 30-60 days | 116days |

*(Source : The Paravet Training Manual - SPC, 2006)*

**Table 3.1.3 Breeding Table for Cow, Doe & Sow**

| Time of Service | Calving Date | Kidding Date | Farrowing Date |
|---|---|---|---|
| Jan 8 | Oct 17 | June 6 | May 2 |
| Jan 22 | Oct 31 | June 20 | May 16 |
| Feb 5 | Nov 14 | July 4 | May 30 |
| Feb 19 | Nov 28 | July 18 | June 13 |
| Mar 5 | Dec 12 | Aug 1 | June 27 |
| Mar 19 | Dec 26 | Aug 15 | July 11 |
| Apr 2 | Jan 9 | Aug 29 | July 25 |
| Apr 16 | Jan 23 | Sept 12 | Aug 8 |
| Apr 30 | Feb 6 | Sept 26 | Aug 22 |
| May 14 | Feb 20 | Oct 10 | Sept 5 |
| May 28 | Mar 6 | Oct 24 | Sept 19 |
| June 11 | Mar 20 | Nov 7 | Oct 3 |
| June 25 | Apr 3 | Nov 21 | Oct 17 |
| July 9 | Apr 17 | Dec 5 | Oct 31 |
| July 23 | May 1 | Dec 19 | Nov 14 |
| Aug 6 | May 15 | Jan 2 | Nov 28 |
| Aug 20 | May 29 | Jan 16 | Dec 12 |
| Sept 3 | June 12 | Jan 30 | Dec 26 |
| Sept 17 | June 26 | Feb 13 | Jan 9 |
| Oct 1 | July 10 | Feb 27 | Jan 23 |
| Oct 15 | July 24 | Mar 13 | Feb 6 |
| Oct 29 | Aug 7 | Mar 27 | Feb 20 |
| Nov 12 | Aug 21 | Apr 10 | Mar 6 |
| Nov 26 | Sept 4 | Apr 24 | Mar 20 |
| Dec 10 | Sept 18 | May 8 | Apr 3 |
| Dec 24 | Oct 2 | May 22 | Apr 17 |

Cow : 280 days
Doe/Ewe : 150 days
Sow : 116 days

The above table is a guide to assist farmers in their production plan.

### 3.1.4 Determining the age of Animals

Age can be assessed roughly by appearance as well as by looking at front teeth; however you won't be able to determine the exact age, especially in older animals.

Determining The Age of Animals by Dentition

**Table 3.1.4.**1 Number & Location of Teeth in Ruminants.

| | | | |
|---|---|---|---|
| **Temporary (Milk) Teeth** | Upper Jaw | No front Teeth | 6 Back Teeth |
| | Lower Jaw | 8 Front Teeth | 6 Back Teeth |
| **Permanent Teeth** | Upper Jaw | No Front Teeth | 12 Back Teeth |
| | Lower Jaw | 8 Front Teeth | 12 Back Teeth |

**Table: 3.1.4.2**

| **Age of Goats and Sheep** | |
|---|---|
| Animal under 1 year | No Permanent Teeth |
| 1 Year | 2 Permanent Teeth |
| 2 Years | 4 Permanent Teeth |
| 3 Years | 6 Permanent Teeth |
| 4 Years | 8 Permanent Teeth |
| Old Animals, > 4 Years | Teeth have begun to wear down |

**Table 3.1.4.3**

| **Age of Cattle** | |
|---|---|
| Under 2 Years | No Permanent Teeth |
| 2 Years 3 months | 2 Permanent Teeth |
| 3 Years | 4 Permanent Teeth |
| 3 Years 6 Months | 6 Permanent Teeth |
| 4 Years | 8 Permanent Teeth |
| Old Animals > 4 Years | Teeth have begun to wear down |

You will not be able to determine the exact age of a ruminant from its teeth, you can arrive at a figure that is within a few months from its actual age. Regular checking of teeth is imperative, not just for age purpose, but also to check on worn out teeth that will inhibits an animal(ruminant) from chewing its cud.

**Table 3.1.4.4 Horse's Teeth at Different Stages of Life**

| | |
|---|---|
| Birth | 2 Temporary Front Teeth |
| 1 month | 3 Temporary cheek teeth on each side |
| 6-9 months | 6 Temporary front teeth |
| 1 Year | 4 Cheek teeth |
| 1.5 Years | 5 Cheek teeth |
| 2.5 Years | 2 Permanent front teeth replace 2 temporary front teeth |
| 3.5 Years | 4 Permanent front teeth |
| 4 Years | 4 Canines & 6 Cheek teeth |
| 4.5 Years | 6 Permanent Front teeth. |

*Source : (The Paravet Manual, SPC, 2006)*

The states of dentition alone are not a totally reliable guide. The type of feed pasture can influence the rate at which teeth ware and fall out.

## 3.2 PERFORMANCE OF PIG

| | | |
|---|---|---|
| Litter size | : | 6-16 |
| Birth-weight | : | 0.6 - 2kg |
| Farrowing Index | : | 2.1 |
| 1st Mating of Gilts | : | 8 months |
| Mating after Weaning | : | 5-7 days |
| Live-weight of Adult Sow | : | 180kg |
| Culling of Sow | : | After 6th-8th Lactations ~ 3-4 years |

### 3.2.1 Feeding of pigs

Piglets: start feeding in the creep as early as possible (about 3 weeks); when piglets eat 1/3 kg (300g) of meal/day each, they can be weaned. This may be at 5-6 weeks with good quality feed but is normally at 8 weeks of age in Fiji.

**Table 3.2.1 Feeding Standards of Pigs (Weaner)**

| Approx.Age Of Pigs (Wks) 8 | Liveweight (kg) 13.5 | F.U./Day* 2.0 | Daily Gain(kg) 0.39 | Carcass Weight (kg) |
|---|---|---|---|---|
| 10 | 18.9 | 2.5 | 0.45 | - |
| 12 | 25.2 | 3.0 | 0.45 | - |
| 14 | 31.5 | 3.5 | 0.48 | - |
| 16 | 38.25 | 4.0 | 0.59 | 20 |
| 18 | 46.35 | 4.5 | 0.71 | 32.13 |
| 20 | 56.25 | 5.0 | 0.71 | 40.95 |
| 22 | 66.15 | 5.5 | 0.77 | 45.68 |
| 24 | 76.95 | 6.0 | 0.77 | 51.98 |
| 26 | 87.75 | 6.0 | 0.8 | 61.56 |
| 28 | 99 | 6.0 | - | 69.98 |

Food units/day (F.U/day) taken on the basic of:-

1. F.U/ = 1.45kg ( 11b) concentrate
= 0.45kg (1 1b) grain
= 0.22 1 (1 gal) skim milk
= 0.28 1 (1.25 gal) buttermilk
= 0.54 kg (10 lb) root crop

**Table 3.2.2 Daily Water Requirement for Pigs**

| Stage of Life | |
|---|---|
| Young Grower | 3-5 litres/day |
| Grower | 5-12 litres/day |
| Pregnant Sow | 12-20 litres/day |
| Lactating Sow | 20-30 litres/day |
| Dry Sows | 12-15 litres/day |

### 3.2.4 Daily growth rate of weaners on different breeds.

| Breeds | Average Birth Weight (kg) | Average Weaning Weight (kg) | Average Liveweight Gain up to Wean (35 days) (g/day) |
|---|---|---|---|
| Large White | 1.52 | 10.1 | 245 |
| Landrace | 1.4 | 10 | 245 |
| Duroc | 1.5 | 10 | 242 |

*(Source - Koronivia Piggery Record)*

The above table portrays the daily growth rate of piglets from birth to weaning on the different breeds of pigs; Large White, Landrace and Duroc. There is no significant difference in their Average Birth weight, average weaning weight and average live weight gained in 35 days.

*Landrace breed at the Koronivia piggery*

*Large White breed at the Koronivia piggery.*

*Duroc breed at the Koronivia piggery*

### 3.2.5 Feeding

From 10days to 25kg live weight the pigs are fed with Pig Starter which is 20% crude protein. Form 25kg to market weight, they are fed with Pig Grower, which is 16% Crude Protein. Breeding pigs are fed with breeder ration, which is 14% Crude Protein.

**Table 3.2.5 Suggested Daily Feed Allowance for Pigs**

| Weight Range (kg) | Concentrate Feed (kg) | Other Feeds (kg) |
|---|---|---|
| 20-25 | 1.0 | 1.6 |
| 25-30 | 1.3 | 2.25 |
| 30-35 | 1.55 | 2.3 |
| 35-40 | 1.75 | 2.8 |
| 40-45 | 1.85 | 2.9 |
| 45-50 | 1.9 | 3.25 |
| 50-60 | 2 | 3.83 |

*Weaners at the piggery in Koronivia*

### 3.2.5 Sales

Pigs (weaners) are sold at 8 weeks and above with a minimum weight of 12kg at a VIP price of $6.85/kg liveweight at the Koronivia Piggery Section; price may varies at Commercial Piggery Farm. Culled animals could be sold at any age.

## 3.3 PERFORMANCE OF GOATS

Birth weight : Single 2.5 – 2.9 kg Twins 2.4 -2.7kg

| Growth Rate | Conventional Systems ( Free Range Grazing) | Semi Intensive System (Supplementary System) |
|---|---|---|
| Birth to Weaning | 60 - 80g/day | 100 - 190g/day (male)<br>90 - 180g/day (female) |
| Weaning to 1year (male) twin | 20 - 40g/day | 99 - 120g/day<br>80 - 120/day (female) |
| Weaning : Single | 10kg live weight or at 3 months | 11-15kg (Male)<br>12-21kg (Female) |
| Weaning : Twins | 4 months | 9-13kg (Male)<br>11-16kg (Female) |
| 1st Mating | 10-15 months | 7-8 months |
| Breeding Intervals | About 7 months | 50 days |
| Average live weight at 1 year | Male : 22-27kg<br>Female : 18-23kg | Male : 37kg<br>Female : 30kg |

***Puberty for both sexes 6-12 months after which sexes should be separated.***

Castration : Best at 2 weeks to 1 month
Mating Ratio : 1 Buck for 25 Does
Gestation : 5 months

***Quality breeder bucks are to kept in the farm and to be replaced after every 3 years.***

Dressed weight is 40% of the live-weight after slaughtering. Note that the 24 hours period from leaving the farm to immediately before slaughter the goat may lose 2-4% live-weight; being kept starved (without food and water). Butchers pay about $15/kg to $18/kg dressed weight. The edible offals; head and forelegs are precluded from the dressed weight and are received free by the butcher.

### 3.3.1 Feeding Standards of Goats

| | | |
|---|---|---|
| Consumption of Supplementary Feed | : | 100-200g/day |
| Feeding : Dry Matter Consumption | : | 3-4kg/day |
| Water Consumption | : | 1.1-4.1kg/day |
| Ratio Water : Dry Food | : | 1 : 2.4-4 |
| Housing | : | 0.5 sq.m of roof area per doe |
| | : | 2.0 sq.m of yard area per doe |
| Grazing | : | |

- ***5 goats are equivalent to 1 cow on grass alone.***
- ***6-7 goats are equivalent to 1 cow on Mixed Grass Shrubs.***

## 3.4 PERFORMANCE OF SHEEP

| | | |
|---|---|---|
| Breed | : | Fiji Fantastic |
| Lambing % | : | 97% |
| Birth- weight | : | Single 4kg, Twins 2.5kg |
| Weaning Age | : | 3 months |
| Weaning Weight | : | 18kg |
| Puberty | : | 6 months |
| 1st Mating | : | 18 months |
| Mating Ratio | : | 1Ram: 20 Ewes (Paddock Mating); 1 Ram:6 Ewes (Handmating) |
| Breeding Intervals | : | 8 months |
| Mortality Rate | : | 5% |
| Life Expectancy | : | Ewe - 7 years |
| | | Ram - 5 years |
| Dressed Weight | : | Fatteners - 35%, Hoggots -40%, Cull Ewes & Rams - 50%. |
| Carrying Capacity | : | 8 Sheep/ha pasture (depend on the topography - 4days grazing) |

## 3.5 PERFORMANCE OF BEEF CATTLE

| | | |
|---|---|---|
| Birth Weight | : | 30-35kg; Brahman Calves are lighter |
| Weaning Age | : | 6 months; wean earlier if feed is limiting. |
| Weaning Weight | : | 145 - 170kg |
| Castration | : | At Weaning |
| Dehorning | : | At Weaning |
| 1st Mating of Heifers | : | Over 275kg live weight of 1.5 years |
| Breeding Interval | : | 12 months ( a breeding interval of 12 months |

gives 100% calving per year but stock with high proportion of Zebhu blood have an average breeding interval of 18 months, with calving rate of 60-65%

| | | |
|---|---|---|
| Mating Ratio | : | 1 Bull : 20 Cows |
| Growth Rates of Steers | : | Natural Pastures 0.2kg to 0.4 kg per day, Improved Pastures ( Signal Grass with Siratro) 0.4kg-0.7kg/ day. |
| Stocking Rate | : | Natural pasture in S.W. Vitilevu about 0.9 cow equivalent/ha (1.1ha/C.E) |
| Dressing Weight for fat Steers | : | 50-55% of Liveweight. |

## 3.5.1 ANNUAL BEEF CATTLE MANAGEMENT CALENDAR

### 3.5.2 CATTLE

**1. Mustering** - all the year round at fortnightly intervals initially and then changed to monthly if cattle control improve. Cattle to be rounded into the cattle yard, counted and recorded into different classes.

**2. Mating Period** - Breeding table (Beef) from December to April when cows are improving in body condition (when pasture availability is high). On all year round mating high conception is achieved during this period, December to April when cows are improving in body condition. A 3-5% (Bull/Cow) mating percentage is preferred. It is advisable to maintain 2 bulls on each farm.

**3. Calving** - from September to January. Calve into the wet season when pasture availability is high.

**4. Weaning** - ( March to May) when calves are 4-8 months old with average weights of 120kg. Calves are weaned to good pastures.

**5. Branding, dehorning, tagging and castration** - February to April. Carried out before weaning to reduce calf stress during weaning.

**6. Drenching** - Drench monthly before and after weaning. Collect faecal sample and send to the Veterinary laboratory at Koroniva to confirm contamination level. Use Nilverm (Levamisole) to control round worms and lungworms at a rate of 9ml per 45kg liveweight.

**Weight:** Weight of cattle can be estimated from chest girth. A tape measure is stretched around the chest behind the forelegs and pulled to a snug fit. The measurement can be read on the chart below to obtain the relevant live weight.

| Liveweight (kg) | Girth Weight (cm) | Dose (mls) |
|---|---|---|
| 45 | 74 | 9 |
| 68 | 86 | 14 |
| 90 | 100 | 18 |
| 113 | 107 | 23 |
| 135 | 114 | 27 |
| 158 | 120 | 32 |

| | | |
|---|---|---|
| 180 | 125 | 36 |
| 203 | 132 | 41 |
| 225 | 135 | 45 |
| 270 | 147 | 54 |

*(Source : Instruction on the Anthelmintics pack label)*

**7. Herd Selection** - November : Select replacement heifers before the mating season. Heifers with over 260 kg body weight. Bull to be change and replace every 3 years.

**8. T.B and Brucellosis test** (All year round). To be carried out during dry period for hygiene reasons.

**9. Sales (May to June)** - Pasture availability decreases towards end of the Wet Season and the animal are in top condition.

**10. Pregnancy Diagnosis** (March to June) Carried out 2-3 months from the end of the . mating period. Maintain selected good breeders in the herd and sell the rest as cull.

## 3.5.3 PASTURE MANAGEMENT

Pasture should be properly grazed with the appropriate number of stock and time to avoid over grazing and maintain quality. At younger stage, pasture will be in its highly palatable form, high efficient intake per bite with less fiber content and less retention time, high absorption rate of nutrient in the digestive systems.

### 3.5.4 PASTURE ROTATION

i) **Pasture Establishment Period - November**

Plant during the early rainy season.

- Introduced grass special on the flats include Setaria (***S.splendida*** & ***S.kazungula***), Para(Brachiaria mutica) and on the hill sides, Batiki Blue (***Ischaemum indicum***) and Koronivia (***Brachiaria humidicola***). Naturalized legumes Hetero (***Desmodium heterophyllum***) mix well with grass species.

ii) **Weed Control & Pasture Improvement**

Continue slashing and remove unwanted planted. Spray with Tzar at the rate of 19mls per 15L of Water. Apply fertilizer - Muriate of Potash @150kg/ha, Urea 350kg/ha in 2 split applications; 1st application in March & 2nd application in October. Weed control is best during the dry periods from June - August.

iii) **Weaner Paddocks**

Maintain and spell pasture at the end of rainy season, well before weaning @ the

rate of 1 head per acre for 4 days.

iv) **Calving Paddocks**
To be well maintained before calving period starts in November. To be secured and strategically located to the homestead.

### 3.5.5 STRUCTURAL

Maintain stockyards
Maintain fences & repairs.

## 3.6 PERFORMANCE OF DAIRY CATTLE

| | | |
|---|---|---|
| Birth Weight | : | Average 27kg - 30kg |
| Age | : | 8-12 weeks, depending on feed & weight. |
| Weight | : | Friesian 80kg, Jersey 72kg |
| Calf Mortality | : | 0-10% (above 10% indicate problems) |
| 1st Mating of Heifers | : | Liveweight 270kg (Friesan), 2 years |
| Age at 1st Calving | : | 2 years and 6 months (3 years) |
| Mating after Calving | : | 75-90 days or at any cycle thereafter. |
| No. of Lactation per Cow | : | 4 |
| Economic Life of Cows | : | 7 years |
| Replacement of Cows | : | 20% Heifer each year |
| Mating Ration | : | 1 Bull: 25 Cows |
| Water Consumption | : | Lactating cows need 4-5 litres water per litre milk produced. |
| Length of Lactation | : | Approximately 270 days |
| Dehorning of Calves | : | As early as possible before weaning. |

| | | | |
|---|---|---|---|
| **3.6.1** | **Breeds** | : | Friesan, Friesan Crosses, Aryshire, Aryshire Crosses, Sahiwal and Sahiwal Crosses |
| 1.1 | **Breeding Table** | : | Dairy |
| | Aim | : | 1 calf per cow per year. |
| | **Breeding Programme** | : | Calving |
| | | : | Service 2-3 months after Calving ( for best results) |
| | | : | 9 months Milking (270 days) |
| | | : | 3 Months Dry Period |

**Mating** a) Run bull with cows
b) i) Natural mating but with bull kept aside.
ii) Control matings - need good heat detection.
c) **Artificial Insemination** - Need good management, especially good heat detection.

*Note:* Check Semen availability before using this option.
1.2 Branding, dehorning, tagging, castration etc.
1.3 Drenching

### 3.6.2 MILK PRODUCTION

A cow will produce three quarters of her total milk production within the first 100 days of lactation. Production in Fiji varies greatly; the best herds averaging 9.0 litres per cow per day for 240 -270 days. Poorer herds give between 2.9 to 4.5 litres.

MILK : 20 - 25L whole milk at 4% butterfat will yield 2-2.5kg Cream or approximately 1kg Butterfat.
Price : Wholemilk - ***$1.00 per litre premium grade***
- ***$0.85 per litre 1st grade***
- ***$0.70 per litre 2nd grade***

Excess Cream in wholemilk (over 3.4% BF) paid separately as Butterfat, at the rate of ***$6.32/kg on Excess Fat***.

### 3.6.3 CALF REARING

***3.6.1 Systems***
a) Calf remains with mother - use of nurse cow
b) Calf left part of the day with mother.
c) Bucket system - Calf taken from mother within first few days of calving and fed from buckets.

***3.6.2 Calf Feeds*** There are 3 common feeds or feeding programmers used in Fiji.
a) Wholemilk
b) Imported Milk replacement powder or proprietary calf rearing powder mixed with water.
c) Wholemilk for an initial period followed by skim milk as the calf grows towards weaning weight.

----------/----------

a) Whole milk fed at about 8% of Body weight for approximately 8 weeks.
b) Milk replacement powder mixed with water and fed as substitute for wholemilk.

*Note:* There are several feeds of this type but availability and prices are often a problem. (eg. Ancalf, Full cream whole milk powder).

* The nutritional analysis of these feeds may vary between products/brands and care must be taken to ensure a consistent diet is offered to the calf.
* After comparative nutritional, especially for fat content, it may be necessary to use different products/brands.

c) Wholemilk followed by skim milk.
Week 1 to 4 : Wholemilk (substitute) at 10% Bodyweight.

Week 5 : Replace with skim milk by gradually feeding more skim milk and less whole milk.
Week 6 to 11 : Skim milk only.
Week 12 : Slow reduction to weaning.

***ALL SYSTEMS***

Grasses and concentrates from 3rd Week.
Post Weaning - Outside grazing and 500 grams concentrates to 1 year.
- Drenching after every 3 weeks

## 3.7 MEAT CHICKEN (BROILERS)

Day old cost (vaccinated against fowl pox) $1.50/chick (Central)
Feed : Can be purchased from Crest Hatchery - Nausori.

**Types of Feed**

| | *Feed Companies* | | |
|---|---|---|---|
| | Pacific Feeds | Crest | Western |
| Broiler Starter | $37.50/25kg | $45.89/25kg | $31.59/25kg |
| Broiler Grower | $38.00/25kg | $45.60/25kg | 25.64/25kg |
| Broiler Finisher | $36.00/25kg | $49.16/25kg | $49.16/25kg |

Feed can be purchased from :
Crest Feed Mill - Nausori. Phone 347 8400
Pacific Feed Mill - Wailada, Lami Phone 336 2258

***Equipment***

1 Tube Feeder - Feeding 50 birds
1 Automatic circular plastic drinker - Serving 80 birds

**Mortality**

During brooding/Rearing - 1%
During rearing phase - 2% - 3%

Total rearing mortality
(Day old to 7 weeks) about 3% - 6%

## 3.7.1 EGG STRAIN BIRDS (LAYERS)

Day old cost - vaccinated - $5.25
(vaccinated against Mareks & Fowl Pox)
Breed - Brown Layers available at Pacific Feeds at Wailada, Lami.

***Types of Feeds***

| *Stages of Growth* | *Type of Feed* | *Price ($)* |
|---|---|---|
| Brooder Phase ( Day old to 6 Weeks) | Layer Chick Starter | $33.00/25kg |
| Rearing Phase (6 Weeks to point of Lay) | Grower Crumble | $31.00/25kg |
| Laying Phase (Point of Lay to Cull: 14-15 months Lay) | Layer Mesh | $33.50/25kg |

***Stocking Rate***
***Deep Litter ( Wood Shavings)***

| Stages of Growth | Number of Stock per Square Meter |
|---|---|
| Brooder Phase (0-6 Weeks) | 20 chicks/sq meter |
| Rearing Phase (6 weeks to Point of Lay) | 14 birds/sq meter |
| Laying Phase (Point of Lay to Cull about 14 months) | 2.5 - 3.5 hens/sq meter |

**Breeding Laying Cages**

| Type of Cage | Recommended Number of Stock |
|---|---|
| Brooder Cages | 66 birds/cage |
| Rearing Cages | 21 birds/cage |
| Laying Cages | 10 birds/cage |

Hurricane lamps or 150 Watts bulbs can also be used to provide heat during brooding phase.

***Mortality***
Brooding Phase Out - 1-2%
Rearing Phase - 4-6%
Total rearing mortality Day Old to Point of Lay - 5-8%
Mortality during Lay 0.75% per month

***Egg Production***

At the age of 28-30 weeks egg production should be peak around 90% and gradually drop as they get old, to 50% at 14 to 15 months.
Feed consumption during lay - about 120g/hen/day.
Cull Hen selling Price - $7-10/bird

# Chapter 4 | Feed and Pasture Analysis & Allocation

## 4.1 FEEDSTUFF AND FEED REQUIREMENTS

A cow requires 10kg green grass per 100kg body weight each day (about a kg dry matter).

Dairy cows cannot reach their milk production potential from the time of maximum milk production, and not later to try to prevent the normal decline during lactation. Supplementary feeding will depend on the cost of feeds and prices for the milk product. Feeding methods will vary, but the aim for greatest net production return is to feed the greatest amount of nutrients (which are lacking from pasture) in the smallest bulk at the lowest costs.

### FEED INDEX

A feed index is one aid in deciding which feed is best value. You can quickly compare the current prices of the feed's actual worth for either Digestible Protein (DP9 or Total Digestible Nutrients (T.D.N) in relation to the common standard of Coconut meal.

Eg. ***Feed Index Relative to Coconut Meal.***

| Feed | Total Digestible Nutrient Index |
|---|---|
| Coconut | 1.000 |
| Mollasses | 0.109 |
| Wheat Bran | 0.758 |
| Rice Pollard | 0.467 |
| Brewer Grain | 0.441 |
| Wheat Pollard | 0.739 |

### *4.1.1 DAIRY CATTLE DAILY REQUIREMENTS*

| | Digestible Protein (kg) | Total Digestible Nutrients (TDN) | Calcium (g) | Phosphorous (g) |
|---|---|---|---|---|
| **Maintenance** | | | | |
| 318kg Cow | 0.218 | 2.68 | 6 | 6 |
| 363kg Cow | 0.245 | 3.04 | 6 | 6 |
| 408kg Cow | 0.268 | 3.31 | 7 | 7 |
| 454kg Cow | 0.295 | 3.58 | 8 | 8 |
| 499kg Cow | 0.322 | 3.81 | 9 | 9 |
| *Milk Production* | ***(per kg of milk to be added to Maintenance)*** | | | |
| For 3.0% B.F | 0.052 | 0.28 | 1 | 0.75 |
| 3.5% BF | 0.055 | 0.30 | 1 | 0.75 |
| 4.0% BF | 0.057 | 0.32 | 1 | 0.75 |
| 4.5% BF | 0.059 | 0.35 | 1 | 0.75 |
| *Pregnancy* | ***Allowances to be added for last 2-3 months of gestation*** | | | |
| Size : Small Cow | 0.249 | 2.49 | 6 | 6 |
| 454 kg Cow | 0.272 | 2.72 | 8 | 7.5 |
| Large Cow | 0.318 | 3.18 | 10 | 8 |
| *Milking Heifer* | ***Allowances to be added for growth*** | | | |

| | | | | |
|---|---|---|---|---|
| 1st Lactation | 0.136 | 0.816 | 3 | 3 |
| 2nd Lactation | 0.068 | 0.408 | 1.5 | 1.5 |

*(Source : Feeds and Feeding - F.B. Morrison 22nd Edition, 1959)*

## 4.2 *PASTURE PRODUCTION*

Pasture production is a critical resource in grazing operations. The interaction between grazing and pasture management influences the profitability & sustainability of livestock enterprises, in particular dairy, beef, sheep and goats.
Pasture management is the process of ensuring pasture persistence, maintaining soil nutrition for growth and making the best use of the pasture.

### 4.2.1 *Improved Pasture*

Improved pasture can play an important role in raising productivity and profitability of an enterprise (Dairy, Beef, Sheep & Goats). Management consideration for improved pasture include:
Pasture growth : By understanding pasture growth, producers are able to maximize pasture utilization while maintaining good land and pasture condition.

Pasture establishment : Preparing and sowing and improved pasture.

Pasture Management : Ongoing management of the pasture to maximize the productivity and persistence of the pasture.

Grazing Management : Organizing livestock to make the best use of pastures grown.

**Table 4.2.1** *Production of Major Pasture Species in Wet & Dry Zones*

| | Wet Zone dry matter/ ha/year (ton) | Dry Zone dry matter/ ha/year (ton) |
|---|---|---|
| Batiki Blue | 18.6 - 26.5 | 0 |
| Batiki/Hetero | 25.5 | 0 |
| Centro | 0.3 - 6.8 | 4.7 |
| Guinea | 28.9 | 0 |
| Hetero | 2.6 | 1.4 - 2.1 |
| Koronivia | 9.7 - 30.1 | 8.9 - 17.5 |
| Mission | 0 | 4.5 - 14.3 |
| Mission/Hetero | 0 | 9.5 |
| Mission/Siratro | 0 | 13.9 - 24.6 |
| Nadi Blue | 0 | 6.1 - 12.8 |
| Para | 16.3 - 40.5 | 0 |
| Para/Centro | 40.1 | 0 |
| Setaria | 25 - 32 | 0 |
| Siratro | 0.5 - 6.3 | 10.3 |
| Stylo | 0.1 - 14.9 | 4.1 |

### 4.2.2 Assessing Pasture Condition

Livestock producers strive for continual improvement of their pastures. One should always consider pastures to not only become productive but also more resilient to fluctuating environmental situations. Producers can realize continuous pasture improvement by implementing a grazing system that rations out forage according to animal requirements, allows for full plant recovery; and minimizes forage waste (Murphy, 1995). The elements of a sustainable grazing system are:

Timing of grazing (corresponding to plant physiological stage)
Intensity of grazing (duration of the pasture).
Assessment of residue or plant height after grazing.
Allowing for plant recovery time after grazing.
Adaptive management of grazing practices, depending on pasture recovery rates (i.e. grazing time on a pasture may increase during less-productive times of the year to allow for more plant recovery time after grazing).
(Source - Rinehart & Baier, NCAT, 2011)

## 4.3 FEED BUDGETTING FOR PASTURES

### Feed Demand

The maintenance requirement of an animal is related to its body weight with additional feed demand during growth, pregnancy and lactation. The annual requirements of various classes of livestock are summarized in Table 4.3.1 which is based on New Zealand work with calculated metabolisable energy valued at 7.5 to 9.2MJ per kg dry matter of pasture.

**Table 4.3.1** *Approximate Annual Dry Matter Requirements & Relativity of Different Classes of Livestock*

| Classes of Stock | Dry Matter Required (kg/year) | Cow Equivalent | Stock Units |
|---|---|---|---|
| *Cattle* | | | |
| *Dairy Cow producing 90kg milk or 1800 litre Milk -* | | | |
| 300kg Liveweight | 3570 | 1.00 | 6 |
| 365 kg Liveweight | 4140 | - | - |
| 400kg Liveweight | 4640 | - | - |
| *Beef Cow Producing 170kg Calf* | | | |
| 365 kg Live weight | 2950 | 0.8 | 5 |
| *Dry Cattle gaining 0.25kg/day* | | | |
| 1-2 | 2100 | 0.7 | 4-4 |
| 2-3 | 2560 | 0.75 | 5 |
| 3 | 3040 | 0.9 | 5-6 |
| Bull | 3500 | 1.0 | |
| *Goats* | | | |
| Doe | 650 | 0.16 | 1.0 |
| Yearling | 365 | 0.10 | 0.6 |
| Buck | 500 | 0.15 | 0.9 |

## 4.4 THE TROPICAL LIVESTOCK UNITS (TLU)

The concept of Tropical Livestock Units (TLU) provides a convenient method for quantifying a wide range of different livestock types and sizes in a standardized manner.

### 4.4.1 What are TLUs?

There is a need to use a common unit to describe livestock numbers of various species as a single figure that expresses the total amount of livestock present - irrespective of the specific composition. The concept of and 'Exchange Ratio' has been developed, whereby different species of different average size can be compared and described in relation to a common unit - This unit is one (1) Tropical Livestock Unit (TLU).

Different formulae may be utilized in different parts of the world, depending on common livestock varieties; e.g 1 TLU = Cattle 0.7; Sheep/Goats 0.1). However a single formula for

estimating TLUs in this way is unable to account for different livestock varieties - which may differ significantly in size - and a different approach is required.

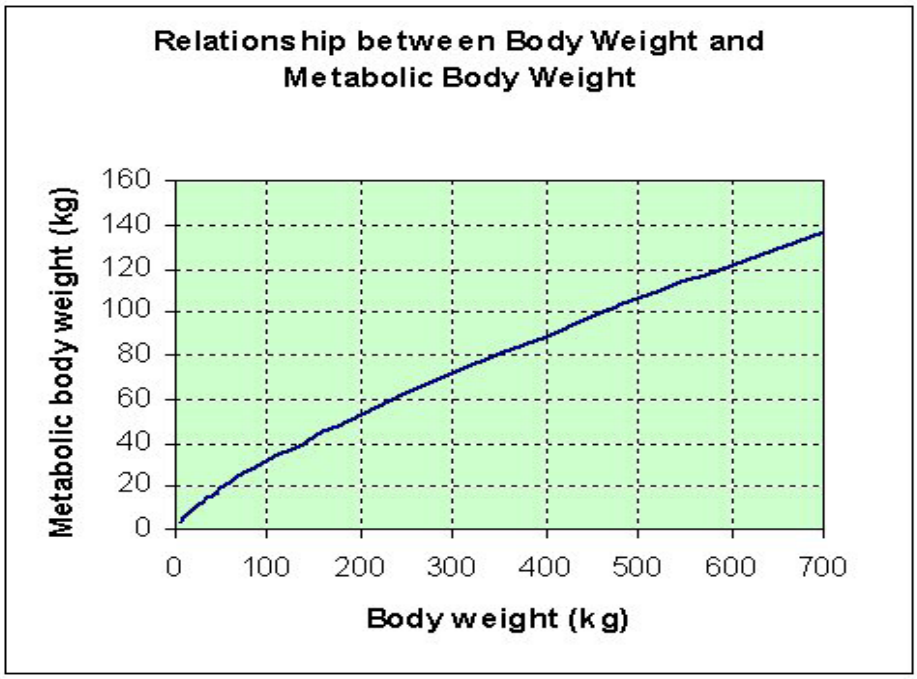
If the feed eaten is reasonably the same for both species being compared, the ration of metabolic weights provides the best means of comparison. This relationship expresses that the fact that smaller animals produce more heat and consume more food per unit of body size than do large animals (Heady, 1975).

Under resource driven grazing condition the average voluntary feed intake amongst species is remarkable similar, about 1.25 times maintenance requirements (1 for maintenance, 0.25 for production = growth, reproduction, milk etc). Metabolic weight is therefore considered as the best unit for aggregation of animals from different species, whether this is for the total amount of feed consumed, manure produced or product produced.

### 4.4.2 TLUs & Exchange Ratios

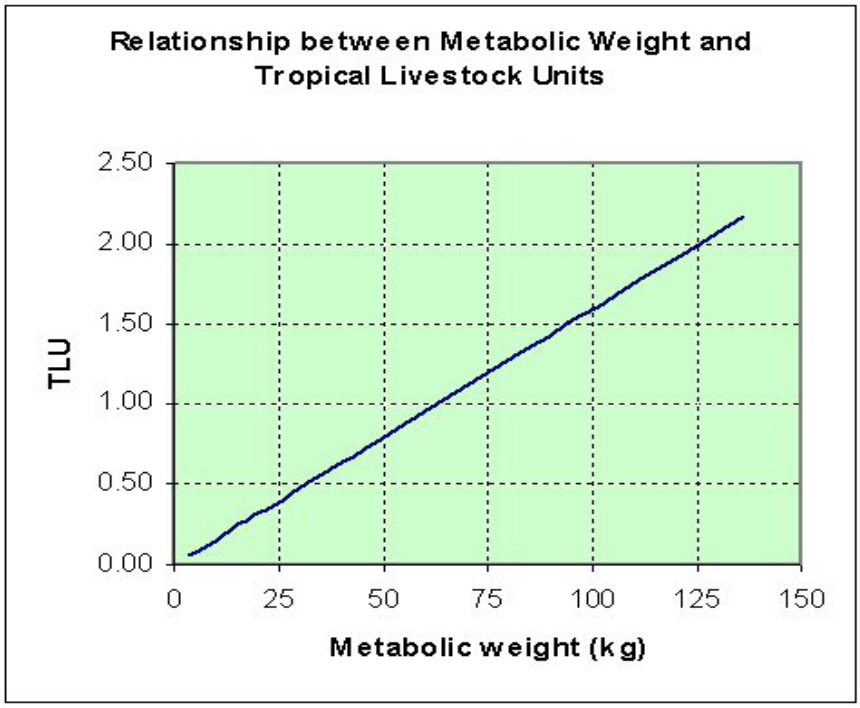
The standard used for one (1) Tropical Livestock Unit is one cattle with a body weight of 250kg. Graph 4.4.2.1, 4.4.2.2, 4.4.2.3 shows the exchange ratios for animals with different body weights in Tropical Livestock Units based on metabolic weight. It shows that 5 sheep or goats of 30kg will consume as much as 1 Cow of 250kg. Comparison will only be possible when the different species consume the same feed.

Table 4.4.2 Ex*change Ratios for livestock in*

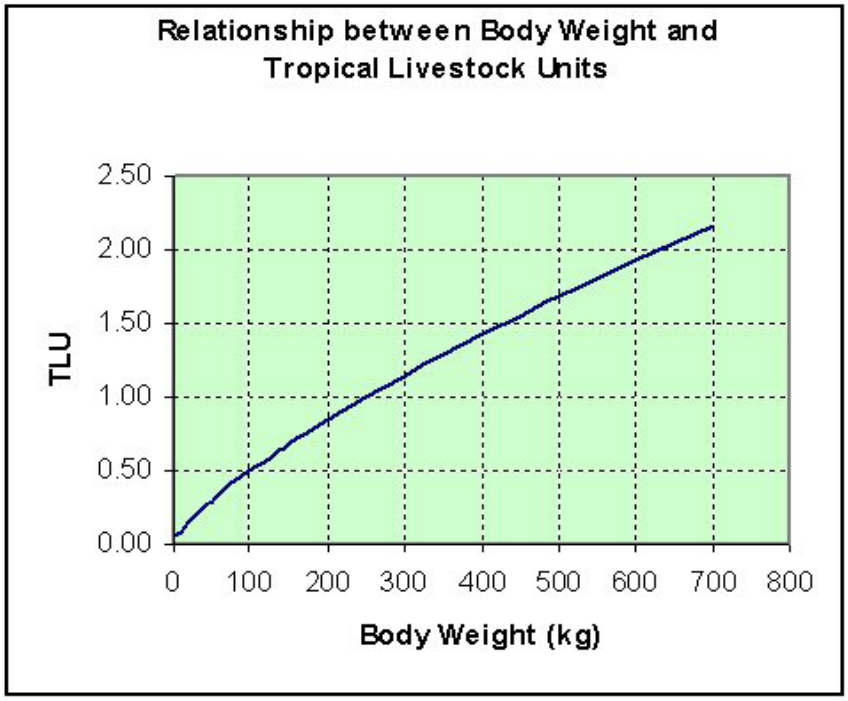


*Tropical Livestock Units based on Metabolic Body Weight*

| Body Weight (kg) | Metabolic Body Weight ($kg^{0.75}$) | T L U |
|---|---|---|
| 5 | 3 | 0.05 |
| 10 | 6 | 0.09 |
| 15 | 8 | 0.12 |
| 20 | 9 | 0.15 |
| 25 | 11 | 0.18 |
| 30 | 13 | 0.20 |
| 35 | 14 | 0.23 |
| 40 | 16 | 0.25 |
| 45 | 17 | 0.28 |
| 50 | 19 | 0.30 |
| 60 | 22 | 0.34 |
| 75 | 25 | 0.41 |
| 100 | 32 | 0.50 |
| 125 | 37 | 0.59 |
| 150 | 43 | 0.68 |
| 200 | 53 | 0.85 |
| **250** | **63** | **1.00** |
| 300 | 72 | 1.15 |
| 350 | 81 | 1.29 |
| 400 | 89 | 1.42 |
| 450 | 98 | 1.55 |
| 500 | 106 | 1.68 |
| 600 | 121 | 1.93 |
| 700 | 136 | 2.16 |



4.4.3 Using Livestock Tropical Units




A number of points need to be noted when using TLUs:

- In respect of grazing pressure there are differences amongst species in grazing/ browsing behavior and in feeding abilities that will alter the exchange ratios. The optimum number of each species in a pasture depends upon the amount of grass and browse available, not upon the total number of TLUs and total biomass.

For example, there is little competition for feed between grazers and browsers and therefore little basis for exchange exists. As a result, a TLU per ha of 0.4 composed of Cattle only can result in overgrazing while a TLU of 0.5per ha composed of cattle sheep and goats can be sustainable.

- Species differ in grazing behavior and abilities, resulting in different opportunities to utilize vegetation. For instance, when feed density is low (onset of rainy season, poor fallow vegetation, early re growth of perennial grasses) sheep can find enough feed to grow. For cattle the equivalent density will still be too low even for maintenance.
- The impact of grazing and browsing on the composition of the vegetation is different. Repeated grazing will result in more browse and repeated browsing in more pasture (Staples *et.al.*, 1942). Early grazing by sheep can reduce grass production - notably when the growing season is short. This can reduce feed avail ability for cattle more than the equivalent of the feed consumed by sheep.

In situations of communal pastures, farmers in general adjust herd composition and periods of grazing according to the available grazing and browse resources. Therefore, at equal levels of TLUs per ha but with large difference in composition of the vegetation, herds may be composed of quite different combinations of livestock species as schematically presented below.

In the case of communal pastures under mixed grazing management systems the relationships of TLUs per hectare with the condition of the pasture and its carrying for livestock are in very ***weak.***

***Tropical Livestock Units*** do, however, provide a reliable estimate of the amount of feed consumed and of manure produced. For these purposes the assessment of total number of TLUs can be useful.

*(Source : FAO, 2014)*

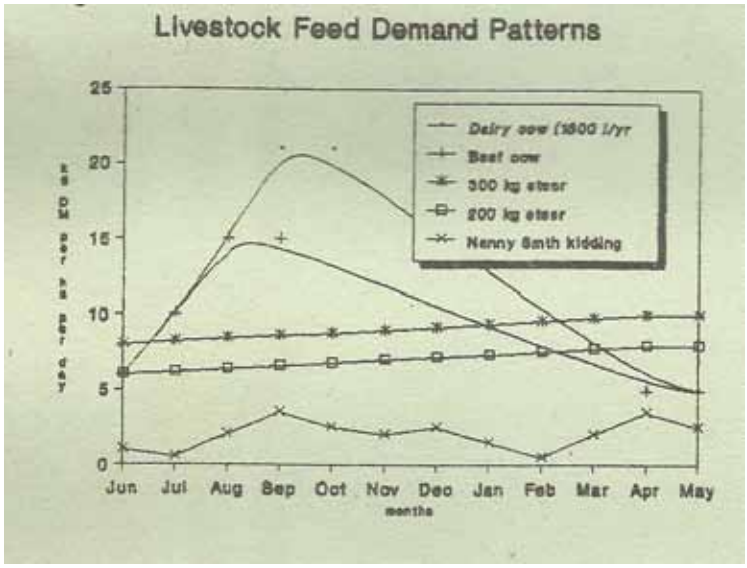



**Figure 4.5.a**

## 4.5 Feed Demand Patterns

The annual feed requirement is the total of the daily requirements throughout the year and the feed demand patterns for various classes of Livestock are quite different. The needs for a dairy or beef cow which passes through maintenance level of mid pregnancy to parturition will have a different pattern form a steer growing at the rate of 0.25kg per day.

When assessing the carrying capacity of a farm, the feed demand pattern must be related to the probable feed supply pattern.

For instance is the feed demand pattern of a dairy herd seasonally mated to calve in August (shown in Fig. 4.5.b) is super imposed on the feed supply pattern at the stocking rate of 3 cows per hectare, the demand will lie within the supply pattern for the month of August and September. This would suggest that calving should be delayed from August (A) to September (B) unless feed reserves can be carried over from the surplus months of May and June.

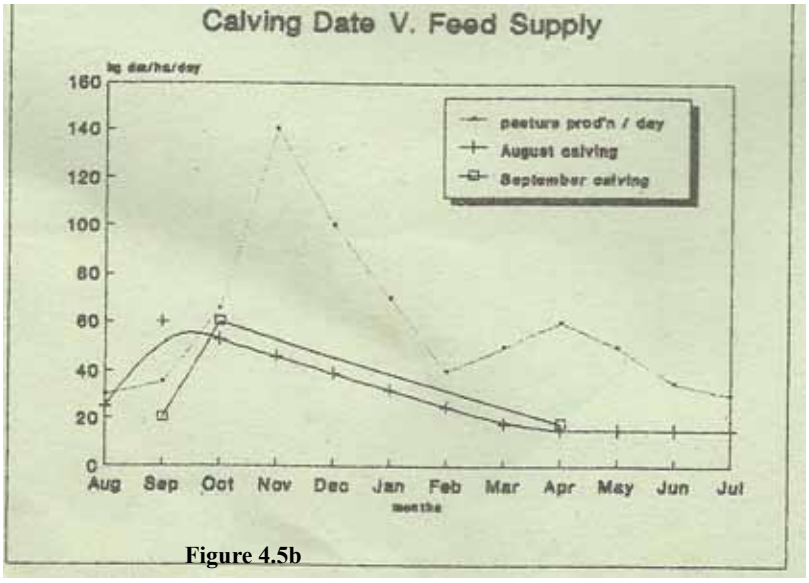



**Figure 4.5b**

## 4.6 Other Measures

Starch Equivalent (S.E) compares all foods in relation to the energy in starch. Thus 100kg of Coconut Meal with S.E of 74 is equal to 74kg of starch. Digestible Protein Equivalent - the percentage of protein of protein like material usable by the animal. Digestible Matter is a measure of Pasture production but intake of pasture by animals is governed by the digestibility and palatability. Fibrous pasture with a low digestibility will have a lower intake by the grazing animal than a less fibrous pasture with a high digestibility. Tropical pasture species have lower digestibility than temperate species.

## 4.7 Feed Quality

The nutritive value of pasture is a function of its energy value and digestibility and its expressed in the following terms. Dry matter (d.m) – food consists of water carbohydrate, protein, fats and minerals. D.M is the residue after extraction of water. Pasture ranges from 10-15 % d.m for lush

fresh growth to 70% d.m for dry herbage.

Digestible organic matter (D.O.M.) – sum of the digestible nutrients of soluble carbohydrate, fiber, fats and protein.

Total Digestible Nutrients (T.D.N) – similar to D.O.M but the fat component is doubled as a truer expression of digestible energy.
Digestibility – percentage of food retained by an animal or dry matter consumed minus dry matter excreted.

b) **Energy System**

When 1kg of dry matter from pasture is burned to its ultimate oxidation products, about 18.44 magajoules (MJ) of gross energy is lost by the animal through execration in faeces, urine and gases from the digestive tract. The gross energy minus the losses is termed metabolically energy (ME.). Thus a value of 7.6 MJ of M.E. per kg d.m. means that in every 1 kg of d.m. 10. MJ of energy are unavailable to the animal.

Note:1 Megacalorie equals 4.2 Megajoules
Four terms are used to express energy values.

***Gross Energy (G.E)*** = The total energy on combustion.
***Digestible Energy (D.E)*** = G.E less energy lost in faeces.
***Metabolisable Energy (M.E)*** = D.E less energy lost in urine & digestible gases as Methane. M.E is the energy used by cells.
***Net Energy (N.E)*** = M.E less energy lost in heat losses; this represents energy stored in the body.

### 4.7.1 Feeding Standards for Beef Cattle

Table 4.7.1 Metabolisable Energy Requirements for Growing & Fattening Cattles

| Liveweight (kg) | M.E of Pasture MJ/kg d.m | Daily Liveweight Gain (kg/day) | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 0.25 | 0.50 | 0.75 | 1.00 |
| 200 | 7.6 | 47.0 | 57.5 | 70.6 | 86.1 | 0.0 |
| | 9.2 | 45.4 | 53.3 | 63.0 | 74.3 | 89.0 |
| | 10.9 | 43.7 | 50.4 | 58.0 | 67.2 | 78.1 |
| | 12.6 | 42.0 | 47.5 | 54.2 | 61.7 | 71.0 |
| 300 | 7.6 | 57.4 | 69.7 | 83.6 | 102.5 | 0.0 |
| | 9.2 | 55.9 | 65.1 | 79.0 | 89.0 | 106.7 |
| | 10.9 | 53.3 | 61.3 | 69.7 | 80.2 | 94.1 |
| | 12.6 | 51.2 | 58.0 | 65.9 | 74.3 | 85.3 |
| 400 | 7.6 | 67.6 | 82.3 | 98.3 | 120.5 | 0.0 |
| | 9.2 | 65.5 | 76.9 | 89.5 | 105.4 | 152.2 |
| | 10.9 | 63.0 | 72.2 | 81.9 | 94.9 | 110.5 |
| | 12.6 | 60.5 | 68.9 | 76.9 | 87.4 | 100.0 |

Table 4.7.1 shows that for maintenance a beef animal weighing 200kg liveweight and grazing a pasture of 9.2 MJ if M.E. per kg of d.m. requires 45.4MJ of ME/day. This animal would need:-

$\frac{45.4}{9.2}$ = 4.93kg of dry matter/day

If the animal were to gain weight at 0.25 kg/day, it would require 53.3 MJ of M.E.or

$\frac{53.3}{9.2}$ = 5.8 kg of dry matter/day

Fast growth of animal is more efficient as a lower parentage of the total intake is used for maintenance.
The table shows that for a particular Live weight gain, cattle require a greater M.E. intake of a low quality pasture than of a high quality one.

Rapid rates of gain cannot be obtained with low quality pasture because:

a. The bulk of food is limited by the rumen capacity

b. Intake is depressed when certain minerals, especially phosphorous, are deficient in the diet. The margin between low and high quality pasture for good growth become more marked as daily live weight gain increase because of differences in the efficiency of utilization of metabolisable energy.

### 4.7.2 Feeding Standards for Dairy Cows

A. Lactating

Table 4.7.2A The M.E requirements for lactating Dairy Cows

| Liveweight | M.E of Pasture MJ/kg d.m | Daily Liveweight Gain (kg/day) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| 363 kg (4.9% Fat) | 7.6 | 53 | 100 | 0 | 0 | 0 | 0 | 0 |
| | 9.2 | 51 | 92 | 139 | 0 | 0 | 0 | 0 |
| | 10.9 | 49 | 86 | 127 | 172 | 225 | 0 | 0 |
| | 12.6 | 47 | 84 | 122 | 163 | 206 | 252 | 263 |
| 500kg (3.8% Fat) | 7.6 | 67 | 106 | 155 | 0 | 0 | 0 | 0 |
| | 9.2 | 65 | 98 | 133 | 179 | 0 | 0 | 0 |
| | 10.9 | 62 | 93 | 126 | 162 | 200 | 241 | 0 |
| | 12.6 | 60 | 91 | 122 | 156 | 190 | 255 | 263 |
| 590kg (3.8% Fat) | 7.6 | 76 | 113 | 157 | 0 | 0 | 0 | 0 |
| | 9.2 | 74 | 106 | 142 | 180 | 225 | 0 | 0 |
| | 10.9 | 71 | 100 | 132 | 165 | 201 | 239 | 283 |
| | 12.6 | 69 | 98 | 129 | 160 | 193 | 227 | 261 |

*(Source : Jaguash 'Pasture & Plants')*

The table 4.7.2A depicts that high yielding cows require a very high quality ration to achieve the necessary intake of Metabolisable energy (M.E).

B Non - Lactating

Table 4.7.2B Metabolisable Energy requirements of Pregnant Non – Lactating Friesian and Jersey cows.

| M.E of Pasture MJ/kg d.m | Friesian Cows | | | Jersey Cows | | |
|---|---|---|---|---|---|---|
| | Number of Weeks before Calving | | | | | |
| | 8 - 4 | 4 - 2 | 2 - 0 | 8 - 4 | 4 - 2 | 2 - 0 |
| 7.6 | 66.4 | 84.8 | 94.1 | 44.9 | 57.1 | 62.6 |
| 9.2 | 61.3 | 77.3 | 84.4 | 42.4 | 53.8 | 58.8 |
| 10.9 | 56.7 | 71.4 | 77.7 | 39.9 | 50.4 | 55.0 |
| 12.6 | 52.5 | 66.8 | 72.7 | 37.0 | 47.0 | 51.2 |

**Table 4.7.2C Metabolisable Energy Requirement for Maintenance of an Adult Sheep**

| Liveweight (kg) | M.E Concentration (MJ/kg d.m) of Pasture | | | |
|---|---|---|---|---|
| | 7.6 | 9.2 | 10.9 | 12.6 |
| 40 | 8.8 | 8.4 | 8.0 | 7.5 |
| 55 | 10.0 | 9.7 | 9.2 | 8.8 |
| 70 | 10.9 | 10.5 | 10.1 | 9.7 |

It is through that goats require a similar standard to sheep. The importance of feed quality is clearly illustrated by these tables.

Poor quality pasture for both young growing animals lactating females is unable to provide sufficient energy for good growth rates or high milk production due to low digestibility and intake lifts from bulk. In Fiji dairy areas with a very high rainfall, the low d.m. of wet and lush can limit total intake of d.m.

No metabolisable energy levels have been established for Fiji pastures but animals performance would suggest levels within the range of 7.6 to 9.2 MJ per kg dry matter. If this is correct, then energy supplement like molasses or coconut meal are necessary to achieve high M.E intake.

Pasture improvement with legumes will increase the digestible protein and energy levels and increases food intake through higher minerals levels.

These figures are generalizations. At times actual pastures values may be much higher as the cow selects a very different diet from herbage taken in samples by mowing.

## 4.8 Management factors influencing feed quality and stock performance.

Pasture plants requires sunlight or solar radiation to grow and the interception of this radiation are related to the leaf area.

Long periods between defoliation, permit plants to maximize light absorption and provide high levels of growth while short periods will depress growth. On the other hand the digestibility of herbage deteriorate markedly as pasture herbage ages and for maximum quality the pasture should be eaten before reaching this stage.

Optimum growth can be obtained with constant defoliation with a stocking pressure which will maintain a constant optimum leaf area index and will allow the animal to select its ration.

Grazing which forces an animal to eat roughage or old grass will decrease the performance of that animal.

This 'mopping up' or rough herbage should be done by classes of animals which are outside times of high feed requirement, like dry cows or mature steers. For these reasons rotational grazing or set stocking can be equally effective. By far the biggest influence on the production per area of land will come from increasing stocking rate.

On mixed pasture with species of very different palatability, set stocking will decrease the palatable species allowing the unpalatable species to become dominant. In Fiji , this occurs with Para grass – Navua sedge pastures and the grass must be allow to over –shadow the sedges either by mowing the sedge or by lax or long grazing intervals.

On hill pastures without sedges e.g. Batiki blue, Nadi blue or Mission grass set stocking will favors legume which are less palatable than the grass for much of the year. This helps to maintain a better grass- legume balance.

**At farmer's level, pasture production and quality can be influenced by the method of rotational grazing or set stocking, by the length of grazing interval, the height of pasture and the grazing pressure or stocking rate.**

### 4.9 Stocking rate and Pasture Utilization

Pasture growth must be fully utilized for good conversion of the grass into milk or meat. While maximum utilization can be up to 85% average levels of in Fiji are closer to 30%. Higher stocking rate are needed to eat more grass but this requires high level of skillful labour.

Optimal pasture utilization in economic terms means the best conversion of herbage into saleable products, which is not the same as maximum utilization by heavy stocking rates of animals fed at maintenance levels.

Table 4.9.1 sets out the three stocking rates and shows the d.m. needed each day per beast to reach the three growth rates. When multiplied by the stocking rate for 250 days , a total dry matter consumption may be calculated.

As the stocking rate increased the level of pasture utilization is also increased but at a lower intake per animal. This reduction is of dry matter used for growth and so lower growth rates are reached.

**Table 4.9.1 Efficiency of Feed Utilisation in Nawaicoba Beef Trial (Source FMBM - Agriculture 1990)**

| Stock Rate (Beast/ha) | Liveweight gain (kg/day) | ME requirement MJ/ beast/day | Dry Matter/ beast/day | Dry Matter/Ha | Total Consumed | % of kg Dry Matter utilised |
|---|---|---|---|---|---|---|
| 1.2 | 0.5 | 63 | 6.9 | 8.2 | 2055 | 25% |
| 2.5 | 0.377 | 58 | 6.3 | 15.8 | 3938 | 47% |
| 5 | 0.145 | 50 | 5.43 | 27.25 | 6788 | 82% |
| | | | | | | |

*A comparison of the dry matter used for maintenance and growth at each stocking rate is given in Table 4.9.2.*

**Table 4.9.2 Dry matter used for maintenance and growth with varying stock (Source. FMBM - Agriculture, 1990)**

| Stock Rate (Beast/ha) | DM for Maintenance | Dry Matter for Growth | Total Dry Matter Used |
|---|---|---|---|
| 1.2 | 1470 kg | 385 kg | 2055 kg |
| 2.5 | 3062 kg | 876 kg | 3938 kg |
| 5 | 6125 kg | 663 kg | 6788 kg |
| | | | |

These data suggest that a stocking rate of 2.5 beast/ha (1 animal per acre) gives the optimum economic utilization, at 47% and that increased utilization is made at lower feed conversion ratios and at a cost to growth.

Pasture composition is influenced by stocking rate and hence pasture production may not be similar for all three types of pasture. The basis mixture of Nadi blue grass and Siratros maintained at 1.2 beast/ha (2 acres/beast) but the proportion of this twining legume was decreased at highest stocking rates.

At the middle rate the legume component was mixed, Siratro and Hetero while at the highest rate (2 beast/acre) even hetero was being eaten out and being replaced by very low growing forms of legume like ***Desmodium triflorum.*** Nadi and Batiki Blue are tolerant of a wide range of grazing pressures but this is not the case with Mission grass and some other

species.

Twinning legumes like Siratro and Centro are rapidly depleted by rotational grazing but have remained vigorous for 6 years so far under a suitable stocking rate.

There is also considerable nutrient recycling from the return of dung and urine, this is faster at high stocking rates.

The dynamic interaction of grass/legume/grazing animal are illustrated but fuller information is not yet available.

***SUMMARY***

Feed Budgeting should match the pattern of feed supply from pasture with patterns of feed demand by Livestock.

Feed quantity and quality requirements vary for different classes of Livestock with different production functions, and for some classes of animal at different stages of production. Feed intake by the grazing animal depends upon digestibility. Utilization of herbage by the grazing animal is increased at higher stocking rates but feed conversion to animal products declines at very high stocking rates.

Pasture supply is affected by the environment but can be augmented through pasture improvement and grazing management. Pasture composition and hence feed quality can be modified by grazing management.

To maintain high performance, high levels of stockman-ship are needed.

# Chapter 4.10 | Freshwater Prawn Farming Practices in Fiji

# FRESHWATER PRAWN FARMING

## 4.10 Establishing a Prawn Farm

Selection of a good suitable site is essential for successful prawn farming. In comparison with Tilapia, prawns are less tolerant to poor pond conditions. It is therefore essential that intending farmers and growers needs to consult a qualified adviser from the Government or a recognized and appropriate agency for sound advice and guidance on any proposal to develop a prawn farm.

### 4.10.1 Site Selection

Below are some of the factors to consider while choosing or selecting farm sites.

- Flat or gently sloping land that does not get flooded.
- Reliable supply of good quality and non polluted fresh water.
- Water source preferably on land owned by the grower.
- Water source preferably at a higher level than the ponds, so that the ponds can be filled by gravity rather than pumping.
- Water discharged from the pond will not mix with water used for domestic purposes.
- Soil has enough clay to hold water.
- Site is located near grower's residence.

### 4.10.2 Initial considerations

Once a site been selected, the following questions must be answered before any further work is carried out.

- Is there any evidence of ownership of the proposed site area?
- Is the land a communal owned one; are there evidences showing approval for leasing or using the site area.

The grower should then check with local authorities for any planned developments or operations upstream that could affect the water source for the ponds (for example, pig or chicken farms, factories, pesticide spraying). There may be also competition for use of land and water sources. For example, fishing, manufacturing industries, public utilities, recreation and other related activities nearby could affect the project and may compete for resources.

In addition, it is important to ensure that the project will not block or interfere with traditional rights of way, underground water pipes and power lines, or work planned by the government.

### 4.10.3 Surveying and planning

A survey should be carried out to decide the layout of ponds, water intake and discharge, access roads, reservoir, power poles, farm buildings and so on. The worst error a prawn farmer can make is to construct ponds quickly without first planning and consulting with the right people. Once constructed, the physical structure of the ponds becomes permanent and it is expensive and difficult to correct mistakes later. Money will be wasted and the project will be difficult to operate if not carefully planned. Poor planning has been a major cause of project failure in several Pacific Island countries.

### 4.10.4 Topography of the site

One of the most important aspects of site selection is suitable topography or "lie-of-the-land". The configuration of the land in terms of water resources and slope greatly affects the efficiency of pond construction and farm operation. Pond construction involves excavating soil or bringing it in from another area. Because

moving large quantities of soil is very expensive, moderately sloping or low and flat areas (with slopes between 1–2% or 1–2 m in 100 m) close to a water source are preferable. Low and flat areas usually require high dykes to protect the ponds from floods. In some instances, soil will have to be carted to the site to make the dykes. If the area is very low, drainage will be a problem.

Very hilly or mountainous areas should be ruled out as it is likely to be too expensive to move large quantities of soil during pond excavation. There may also be a problem in finding somewhere to put the excess soil. While this could be solved by constructing high, wide dykes, large dykes result in a smaller pond water area.

### 4.10.5 Climate

Consider the climate of the area to help decide whether prawns can be cultured year-round or only during certain times of the year. The interaction between climate and farm site determines the suitability of the site for pond production of *M. rosenbergii*. Important climatic factors include:

- rainfall
- temperature
- sunlight
- wind exposure

The temperature of the pond water is the most important factor in deciding the best time to stock the ponds and the number of yearly harvests. For example, prawns will only grow well when the water temperature can be maintained at 22–32°C for 4 to 6 months, which is the period needed to grow-out prawn PL to a marketable size.

The temperature of the water in the pond is controlled by the combined effects of the temperature of the incoming water, air temperature, solar warming, wind and evaporation. Pond-water depth also affects the water temperature. For example, ponds with a surface area of 500–1000 $m^2$ and water depth of 80–100 cm are preferred. To ensure that a good water balance is maintained, the evaporation loss should be equal to or slightly lower than the amount of rainfall and incoming water combined. However, in some islands and locations, this balance will change seasonally with periods of high rainfall (when deeper ponds are preferred) and high evaporation (which reduces the amount of water in the pond).

Wave action resulting from wind helps to oxygenate the water. However, strong winds can increase water loss by evaporation and generate excessive wave action, which erodes the dykes.

### 4.10.6 Water supply

*Macrobrachium rosenbergii* is normally farmed in fresh water and in some places in slightly saline water (<7 ppt is acceptable). Water can be obtained from surface water sources, which include rivers, streams, creeks, reservoirs and irrigation canals, or from sub-surface sources such as springs, wells and boreholes. The farm should have its own independent water source or supply that is delivered to the farm through a suitable system or, where possible, by gravity flow. The water source must not be shared with a school or village water supply and must be free from pollution, particularly agricultural chemicals and pesticides, and any predators and competitors.

Regardless of water quality, prawns cannot be raised successfully unless there is enough water available. A bulk supply of water (from a river, lake, canal, or purpose-

built reservoir) is ideal. It is also important that the water source does not dry up in the dry season or during droughts. When water levels in creeks, streams and rivers fall too low, the water quality can change and become unusable. Water is needed to:

- fill the ponds initially
- top up the ponds to replace water lost through seepage or evaporation
- partially flush the ponds with clean water regularly
- in emergencies, flush out ponds if prawns are dying as a result of poor water quality.

As a general rule, it is necessary to have enough water to be able to flush through approximately 10% of the volume of water in each pond each day or at least every two days. A water pump will be required if the pond cannot be either filled or drained using gravity flow. The costs of fuel or electricity for the pump, and maintenance of pumps and hoses should be taken into account in the feasibility study as these are all expensive.

Water from fast-flowing rivers or streams with rocky or stony beds is usually rich in oxygen, has a moderate amount of nutrients, and may contain no pollutants. This is the preferred source. Well water or bore hole water can also be used, but these sources are poor in oxygen and nutrients. Water from marshes or peat swamps should be avoided as it is acidic.

The quality of the water should be tested to see whether values for temperature, pH (acidity), DO (dissolved oxygen), hardness, salinity and other factors are in the ranges known to be good for prawn growth and survival (Table 2). In most cases, farmers do not have access to the equipment needed to make these checks. However, these services can be requested from the Fisheries Department or provided by a professional water analytical laboratory. If investing in a large farm, the grower should buy and learn to use hand-held meters for measuring pH and DO to make daily water quality checks.

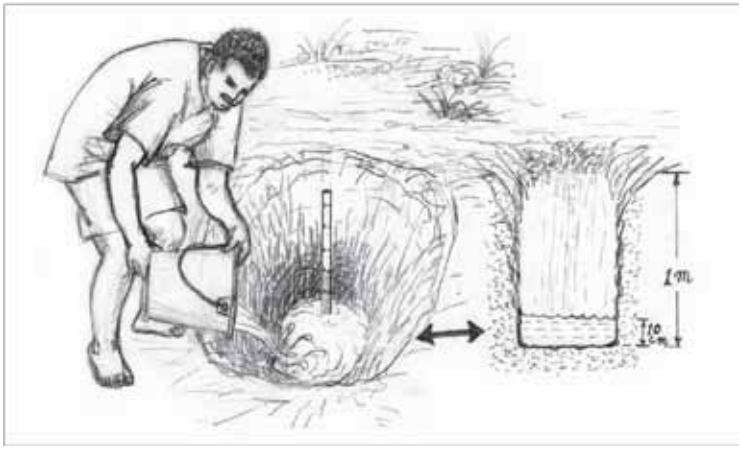
Below is a summary of the ideal range of values for various water quality factors (experience has shown that these values are good for prawn survival and growth):

- Water temperature: 26–31°C (at least 120 days of water temperature >22°C).
- Dissolved oxygen: 3–7 ppm (minimum 3ppm at dawn).
- Acidity: ideally pH 7.0–8.5.
- Hardness as calcium carbonate (CaCO): range 30–150 ppm.
- Salinity (saltiness): ideally fresh water (0 ppt), preferably less than 7 ppt for good survival and growth.
- Water Colour : Light green or light brown.
- Water Transparency: 25 - 40cm

### 4.10.7 Soil

Soils for pond construction should be composed of clay, silt and some fine sand. The physical strength, permeability, plasticity and physico-chemical interactions of the soil need to be considered in making decisions on overall site suitability and the most appropriate method of pond construction. It is recommended that soils contain at least 20–50% clay to prevent excessive seepage of water from the pond. If the soil is too sandy, the pond banks will erode easily and water will seep through the pond sides and bottom. If there is porous soil under the pond site, such as sand or gravel, and there is no suitable alternative site, then a layer of

clay soil should be compacted over these areas to prevent excessive seepage.




Three simple tests can be used to check whether the soil has enough clay content: the water retention test (Fig. 1), and the soil ball and soil ribbon tests (Fig. 2).

**Figure 1. Water retention test**

- With a spade, dig three or four pits (holes) of 30 cm diameter and 1m depth in different parts of the proposed pond site.
- Fill the pits to about 10-20 cm with buckets of Water
- Wait for 15 minutes for the surrounding soil to get thoroughly wet, then make a mark on a stick, and drive the stick into the pit bottom so that the mark matches the water level.
- Check each pit again after an hour or so, take the new level mark, and measure how much the water level has dropped in millimeters. If the level has dropped by 3mm/hour or less, the soil is suitable for pond construction. If the level drops by more than 5 mm/hour, the soil is unsuitable.

*Soil ball test*

1. Take some of the soil dug earlier from the pit.
2. Wet it slightly and form it into a round ball, slightly bigger than the size of a fist.
3. Drop the ball from head height onto flat ground. If the ball retains its shape, or goes only slightly out of shape, it contains enough clay for pond construction. A ball made from soil that is too sandy will flatten out, crack open, or even shatter on hitting the ground. Alternatively, if the ball remains intact and does not crumble after considerable handling, there is enough clay in the soil.

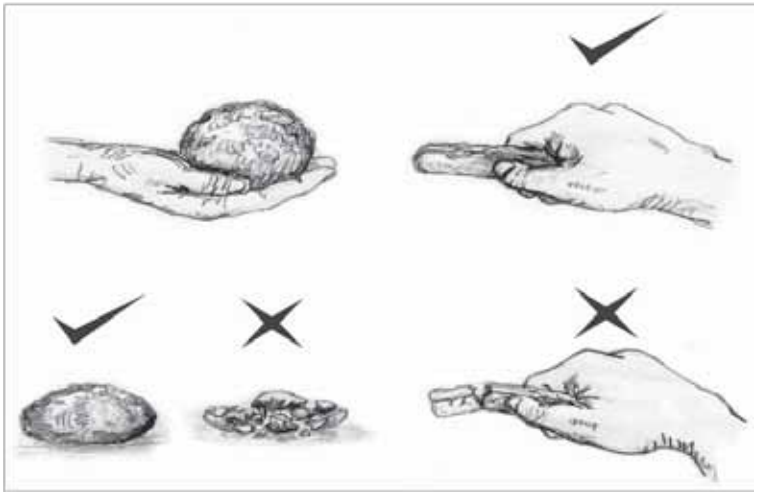


**Figure 2. Soil ball test (left) and ribbon test (right)**

*Soil ribbon test*

1. Take some of the soil dug earlier from the pit.
2. Wet it slightly, and try to mould it into a flat ribbon of earth about 3cm wide and 6mm thick. If the moist soil forms into a ribbon of this size, then the soil contains enough clay. If the ribbon cracks and falls apart, this indicates the soil is too sandy to hold water and is thus unsuitable for pond construction.

### 4.10.8 Other factors

### 4.10.9 Flood hazards

The risk of floods in the area needs to be considered. Since floods cannot be controlled, it is important to know whether the ponds will be safe during floods. If not, flood frequency and the extent of likely losses must be taken into account in financial forecasts.

Rainfall records for the past 10–15 years should be analyzed. The size of creeks, rivers and drainage canals should also be checked to see whether they can take the run-off water from the pond site. The height of the biggest flood that has occurred in the area can be found by studying flood records from the government weather station and also by talking to people who have lived in the area for a long time.

### 4.10.10 Availability of technical assistance

Access to technical services and advice during the construction and management of the farm is very important for the successful operation of a prawn farm. These services are usually provided by government extension services, research institutions and NGOs or financing institutions. In the past, aquaculture projects have failed in Pacific Island countries because growers have not had sufficient technical back-up or follow-up services.

### 4.10.11 Source of prawn post-larvae (PL)

The availability and cost of PL from local hatcheries or other sources, including the cost of transporting PL from the hatchery to the farm, should be worked out during the planning stages. There is also a need to consider the following:

- Will there be enough PL supplies to stock the ponds whenever required?
- Is the hatchery close enough to the farm to ensure that the PL will arrive in good condition?

### 4.10.12 Availability and cost of supplies and equipment

Ensure that supplies, such as feed and the equipment needed for the project, are available in the area or in the country. For example, fine-mesh net material for screens might be difficult to obtain or may be available only sometimes. If materials have to be imported, there may be restrictions or extra costs involved.

### 4.10.13 Availability of skilled labour

Locally available skilled labour is usually cheapest and should be used with due respect for customs, traditions and work ethics to ensure smooth operation of the farm.

### 4.10.14 Prawn farm facilities

Freshwater prawns are raised in earthen ponds, reservoirs, irrigation canals, ditches, pens, plastic-lined ponds or concrete ponds. The facilities used for prawn farming are similar to those used for farming fish such as tilapia and carp.

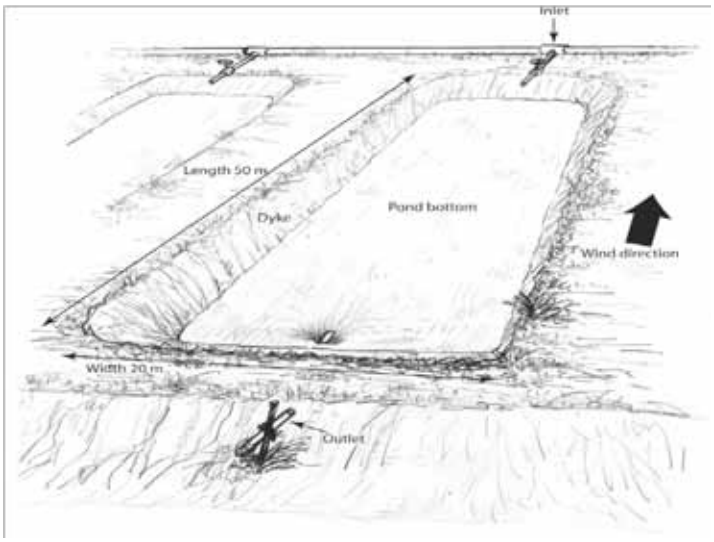
### 4.10.15 Pond structure

Before a pond is constructed, the site should be surveyed to determine the elevation and best layout for water intake, discharge of water, access roads, elevation of dykes, pond bottom and structures such as piping (Fig. 4). Ponds should be designed to completely drain within a day. This requires a slope of approximately 0.2–0.3%, or 20–30 cm per 100 m of pond length. Below are some of the features of a well-built pond.

### 4.10.16 Size and shape

The number of ponds and pond sizes depend on the availability of suitable land, financial resources, cost of construction and other factors. For example, ponds with a surface area in the range of 500–2000 $m^2$ are easy for a single household to manage. The amount of water available and the continuity of supply may also set an upper limit on the potential pond area of the farm. Although the number of ponds is a personal decision, several small ponds will cost more per surface area than a few large ponds.

**Figure 3. Overall view of ponds**




Rectangular ponds are preferable as they are more suitable for harvesting using a seine net. The size of the pond will depend on the availability of land and the farmer's choice of length and width. A length of 20–100 m and width of 15–20 m are recommended. These dimensions will also match the size of the seine nets used for harvesting (the nets are usually provided by Fisheries Departments).

In places where dyke erosion from high winds will be a problem, the long side of the pond should be parallel to the prevailing wind direction (Fig. 4). If the area does not experience strong winds, the pond should be aligned to take best advantage of the wind blowing across the pond to facilitate mixing of the water in the pond.

The pond bottom should be smooth and free of any obstructions to make seining easier.

### 4.10.17 Pond depth

The depth of the pond plays an important role in the physical and chemical parameters of the water. For example, when the water is more than 3 m deep, there may not be enough photosynthetic activity at this depth to keep the deeper water oxygenated. There will also be difficulties in mixing the water through the action of wind and waves. The water temperature remains colder at this depth too, resulting in less plankton. The right water depth helps to regulate temperature and inhibit growth of underwater plants. At the same time, water needs to be shallow enough to maintain dissolved oxygen (DO) levels at the pond bottom. Ideally, the pond depth should be 80 cm at the inlet end and 120 cm at the outlet end, excluding the free board (see 5.1.3), for ponds of 200–2000 $m^2$ that have a good water supply. For rain-fed ponds, a water depth of 1.5 m is desirable at the outlet end.

### 4.10.18 Freeboard

The freeboard is the additional height of the pond dyke above the maximum water level. In other words, it is the vertical distance between the water surface in the pond at the designed depth, and the height of the dyke after dyke settlement. It prevents overflowing or overtopping of water due to heavy rainfall or wave action. A free board of 0.4–0.5 m is usually necessary to keep the prawns safe. An overflow or outlet pipe is also provided at the maximum water level.

### 4.10.19 Bunds (dykes, pond walls or bundh)

The top of the dyke (crest) is usually 1.5–3.0 m wide, or equal to the average height of the dyke (Figs 5 and 6). A much wider crest is required if vehicles are to drive along it. It should be noted that a wider crest requires a large area for the dyke and also a larger volume of soil, involving higher costs.

The design of the dyke should be strong enough to hold the maximum level of water and withstand the water pressure. It should also be stable and wide enough to prevent seepage. The inside slope should be no more than 2:1 for small ponds, increasing up to 4:1 for larger ponds. A gentle slope to the pond sides will help prevent erosion and make it easier to manage the pond.

The top 10–15cm of soil on the dyke profile should be removed to get rid of vegetation and organic matter, thus ensuring a good bond with the excavated pond soil. If the soil for dyke construction is brought in from another area, then it should not contain large amounts of rocks, sand, wood, grass or plants as these will cause seepage.

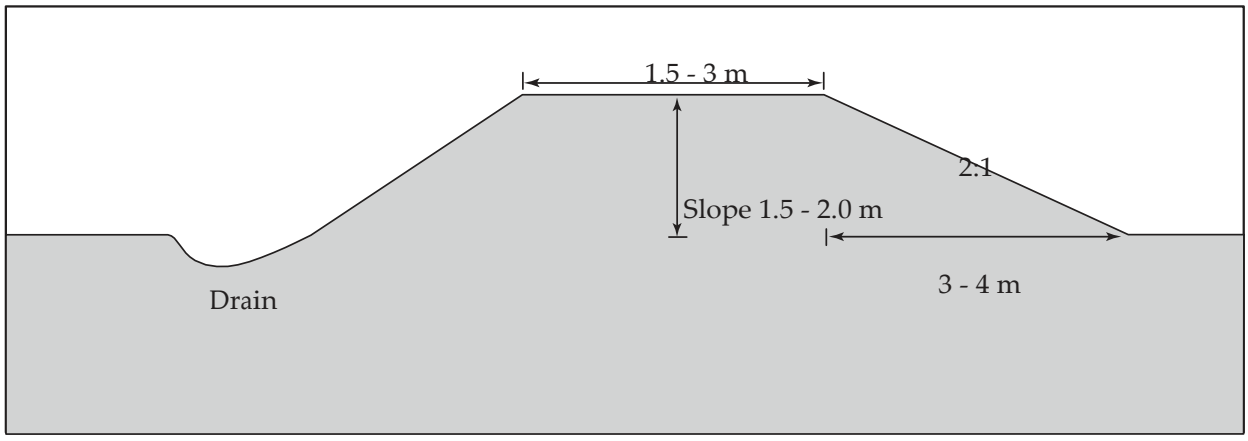



**Figure 4. Dyke dimensions**

### 4.10.20 Water supply and distribution

There must be plenty of water available throughout the culture period. As mentioned earlier, the water source is usually at a higher level than the pond water level so that it can be distributed by gravity flow through pipes or open channels. Water can also be pumped into ponds and culture facilities.

Each pond should have its own water supply from the central water distribution channel that brings water from the water source. In larger ponds, the flow of water into each pond must be controlled by valves (if piped) or shut-gates (if channeled).

There should not be any contact between incoming water and water drained or discharged from the ponds. Furthermore, ponds should not receive water

discharged from any other pond. Transfer of water from one pond to another is not recommended since it means poorer water quality in the subsequent ponds and increases the risk of transferring disease.

### 4.10.21 Water inlet

The water inlet is a hollow pipe or open channel in the dyke that allows water to flow into the pond. It should have a screen to keep out wild fish, twigs, leaves and other trash. It should also have a gate valve or shut gates. Usually, 50–100 mm diameter PVC pipe is adequate to fill ponds of 500–2000 $m^2$.

### 4.10.22 Water outlet

The water outlet allows water to flow out of the pond (Fig. 7). The end of the outlet pipe inside the pond should be screened to prevent the prawns from escaping. The number of outlet pipes (drain pipes) and their diameter depend on the size of the pond. These pipes must be installed at the deepest part of the pond. Pipes with a diameter of approximately 150 mm are needed to drain 2000 t of water (that is, a 2000 $m^2$ pond will need at least two 100 mm diameter pipes). With this flow capacity, the pond will drain completely within a day. If more pipes or larger diameter pipes are used, then the pond will drain faster. For smaller ponds of 200–1000 $m^2$ in size, a 100 mm diameter pipe is usually adequate.

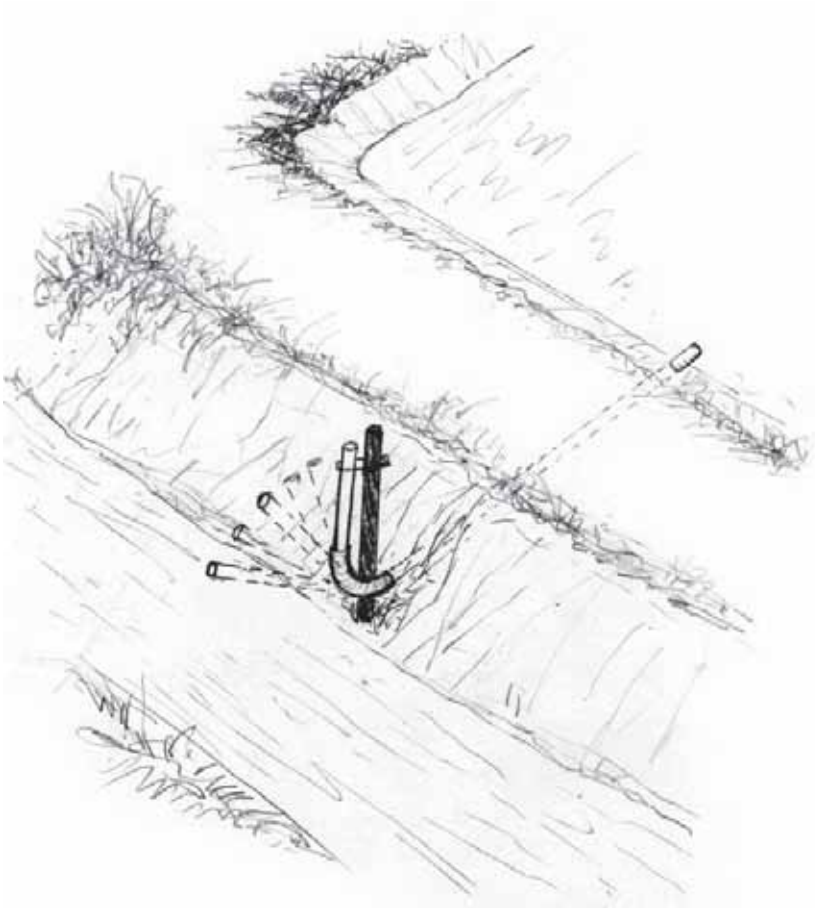


**Figure 5. Position of water outlet pipe**

### 4.10.23 Overflow pipe

An overflow pipe should be installed near the water outlet to allow excess water

to flow out of the pond during heavy rainfall. It should also be screened to prevent the prawns from escaping.

### 4.10.24 Screening water inlets and outlets

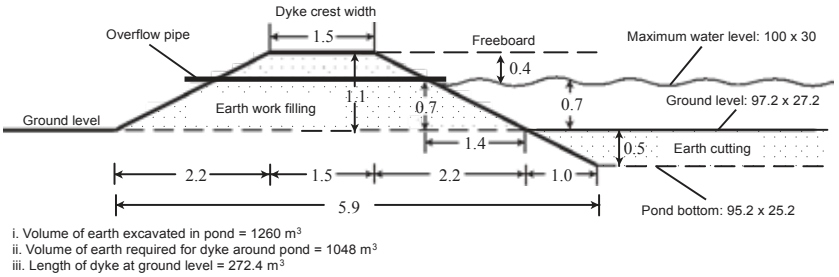
Box screens are an effective way to prevent pest fish from entering the pond. Galvanized or plastic 1mm mesh (similar to a mosquito screen) is used on both inlets and outlets. Cloth filters on the inlets may be necessary to remove fish eggs if the water comes from a river or canal.

### 4.10.25 Mechanical pond construction

Heavy machinery used for pond construction includes excavators, bulldozers and backhoes. Bulldozers are best due to their rapid earth moving capabilities and good compacting action. Excavators are a little slow but are very good for making pond dyke slopes and drains. In areas with a high water table, the soil may be too soft to support such heavy equipment. The local aquaculture officer or other appropriately qualified person should be present to supervise the digging operation to ensure the required procedures are followed.

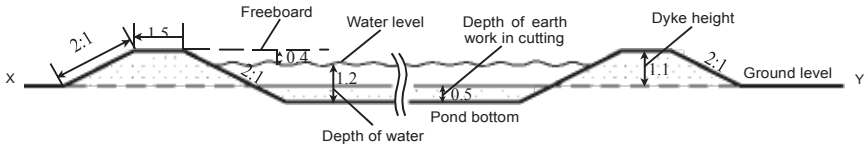
The usual method is to dig out the pond area and use the fill to construct the pond dykes. During excavation, the machine is run over the pond banks while they are being constructed to continually compact the soil.

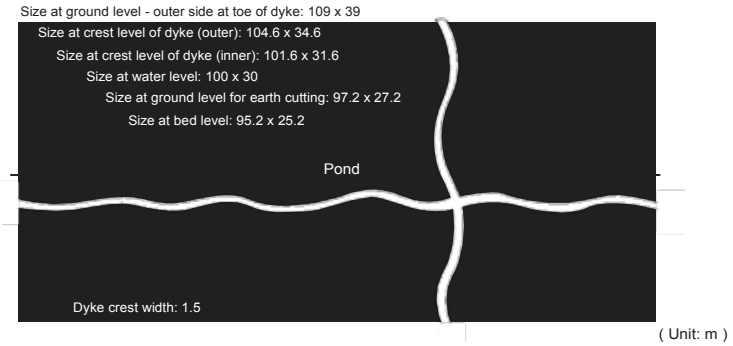
The design and layout of the pond is the same as for a hand-dug pond with some modifications. The machine operator should be thoroughly briefed on pond shape, size, bottom slope and other features (see Fig. 5 and Fig. 9) and should follow similar procedures to those described for digging a pond manually. Construction should preferably be done during the dry season.




i. Volume of earth excavated in pond = 1260 $m^3$
ii. Volume of earth required for dyke around pond = 1048 $m^3$
iii. Length of dyke at ground level = 272.4 $m^3$

**Cross section X-Y**




( Unit: m )

**Example of calculation of costs for pond constructed by machine on level ground:**

The cost of constructing farm ponds and related structures must be budgeted for. As the pond is the most expensive structure, the estimated cost of constructing a typical pond of 0.3 ha in size is given below.

It is much cheaper to construct a pond on level ground, mainly due to the limited depth of cutting required. For example, a grow-out pond of 100m x 30m (size at water level) requires 1260 $m^3$ of earth to construct a dyke of 1.1 m high above ground level (1.5 m including freeboard) with side slopes of 2:1 and crest width of 1.5 m (see Fig. 9):

Dyke slope.....2:1
Dyke slope (outside) .....2:1
Crest width of dyke.....1.5
Depth of pond at maximum water level.....1.2 m
Depth of pond at bed level (average depth of earth excavation).....0.5 m
Freeboard.....0.4 m
Considering the above, the pond size at different levels comes to:
Size of pond at maximum water level.....100 x 30 m
Size at ground level (where excavation will be started.....97.2 m x 27.2 m Size at mid-depth of excavation.....96.2 m x 26.2 m Size at pond bed level.....95.2 m x 25.2 m Size at crest level of dyke (inner).....101.6 x 31.6 m Size at crest level of dyke (outer).....104.6 x 34.6 m Size at outer toe of the dyke, that is, the total land area. .....109.0 x 39.0 $m^2$

The volume of earth excavation can be calculated by using the prismoidal formula: V = A + 4B + C x D
6 where
V = Volume of earth in excavation, in $m^3$
A = Area at ground level from where the earth cut starts, in $m^2$ B = Area at mid-depth of cutting, in $m^2$
C = Area at pond bottom, in $m^2$ D = Depth of excavation, in m
The amount of earth required to construct the dyke is calculated as follows: Volume of dyke = central length of pond dyke x area of dyke
Area = (top and bottom) width of dyke section x height of dyke

This means that the amount of earth required to construct a 1.1 m high dyke around the

pond is approximately 1108 $m^3$. The quantity of earth produced by excavating a 0.5 m deep pond is 1260 $m^3$. Using more earth than necessary to construct the dyke will reduce the pond area and thus the volume of water it can hold. It will also cost more. To avoid excess earth, the pond excavation depth can be reduced slightly. The estimated cost of excavating a pond is based on the quantity of earth to be moved and, of course, varies from country to country. Consult an appropriately qualified person for advice; for example, your local fisheries officer.

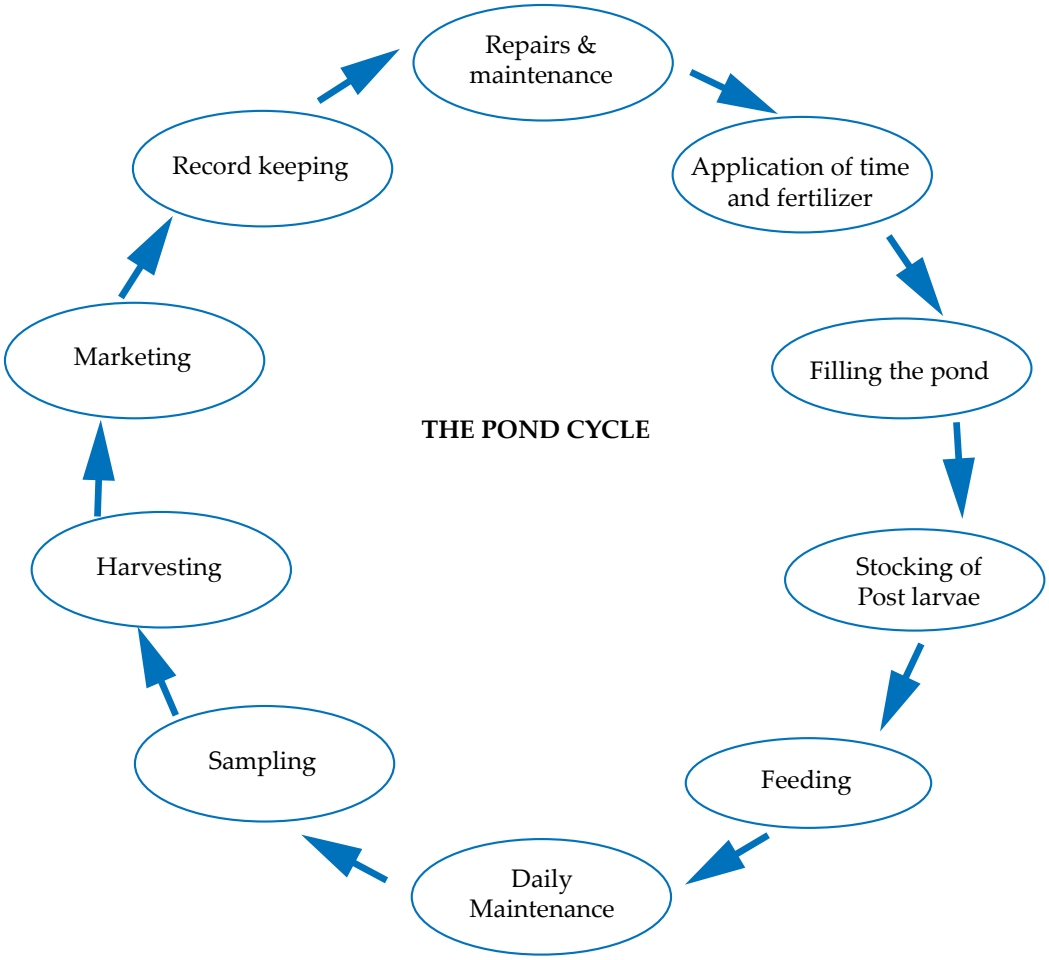
### 4.10.26 Grow-out in ponds — the pond cycle

The profit from prawn farming depends on two factors: (1) the yield and market price of the prawns, and (2) the cost of production. These two factors must always be kept in mind during grow-out.

The following features of the grow-out phase are critical for profit:

- Size and quality of the post larvae at stocking
- Stocking density of Post Larva in the pond
- time of stocking
- feed and feeding methods • management of the ponds • length of culture period
- size of prawns at harvest.

The activities involved in grow-out of prawns are like a circle with a series of steps that — when completed — take the operation back to the start. This is called the pond cycle (Fig. 10). To get good yields, the farmer must carry out each step in the pond cycle and be aware of the interactions between them. Each step is described in detail in the following sections.



### 4.10.27 Repairs and maintenance

After any defects in the pond have been repaired, the pond must be prepared to create a favorable environment for prawn growth. This includes completely draining the pond, eradicating pests, removing rubbish and excess silt, leveling the pond bottom, checking the dykes and water pipes, and cutting any overgrown grass on the bottom. It is also preferable to allow the pond to dry until the pond bottom cracks. Usually it is easier to carry out repairs and maintenance in a dry pond. The grass on the dyke crest and around the pond should also be trimmed to allow the breeze to blow over the pond water, enhancing oxygenation. However, do not remove all the grass on the dykes as it helps to hold the soil on the dykes and reduce erosion.

The screens on inlet and outlet pipes should be repaired or replaced. Drains should be cleared of plants, rubbish, or any other possible blockages.

### 4.10.28 Application of lime and fertilizer

Acidic water will not support the growth of phytoplankton, zooplankton and bacteria. All these organisms are important to provide the right environment for prawn growth. Acidic conditions also affect prawn shell development. Where the soil pH (measure of soil acidity) is less than pH 6.5, lime needs to be added to the ponds to correct the acidity of the pond soil to create a favorable environment for the prawns. The soil pH must therefore be measured. This is usually done at the start of the project. The pH can be measured using portable color-test kits, or by a pH meter at a water quality laboratory. The Fisheries Department may assist with this testing, usually at the start of the project.

The pH of the water is a measure of acidity (the hydrogen ion content in the water). The water is "acidic" when the pH is 1–7 and "basic" or "alkaline" when the pH is 7–14. At pH 7 the water is "neutral". The recommended pH for good growth of prawns is 7.0–8.5, though 6.5–9.0 is acceptable. If the pond is limed properly during its preparation, there is no need to add any more lime while prawns are in the pond.

The pH of the pond water will vary throughout the day. When the sun is shining, phytoplankton (microscopic plants) remove carbon dioxide (CO ) from the water and use it for photosynthesis. This raises the pH of the pond (making it less acidic). A heavy plankton bloom during sunny weather can cause the pH during the day to rise as high as pH 9.0. At night, however, phytoplankton will release dissolved CO , causing the water to become more acidic and the pH to drop again. These day–night fluctuations in pH are normal and there is no need to worry about them as long as the pH values are mostly in the acceptable range of 6.5–9.0.

### 4.10.29 Applying lime and pest control treatments

Liming is generally not necessary in areas with a lot of limestone (CaCO ) because the soil in these areas is not usually acidic. Lime may be necessary near mangrove areas where acid-sulphate soils are found.

Before applying lime and any other treatments, ponds must be drained and prepared. If ponds cannot be dried out completely, they should be treated to eliminate any predatory fish or other pests, 7–10 days before stocking. Common pond treatments are tea-seed cake, rotenone, quicklime (CaO). When applying lime or other treatments, operators should wear protective clothing (Fig. 8).

There are several forms of lime. The most common type of lime available is agricultural lime or powdered limestone (the kind used by gardeners). Other types include quicklime and hydrated lime. They differ in strength so have different application rates. Quicklime

and hydrated lime also kill unwanted pests so they can be used instead of tea-seed cake or rotenone (see below).

Rates of application:

- limestone (powdered): 1000–2000 kg/ha
- quicklime: 400 kg/ha
- hydrated lime: 600 kg/ha.

Limestone. Agricultural lime (powdered limestone) can also be used to raise the pH of pond water. The rate of application for limestone is generally twice that of quicklime. It should be added to the pond before filling with water.

Quicklime. When quicklime absorbs water, it becomes calcium hydroxide (Ca(OH) ). This raises the pH and draws oxygen from the water. As well as reducing soil acidity (raising the pH), quicklime kills unwanted fish, pests and bacteria.

Application rates for lime range from 1 kg for every 10 $m^2$ for established ponds to 1 kg per 5 $m^2$ for new or very acidic ponds. This equates to a range of 100 $g/m^2$ to 200 $g/m^2$. If the pond is 1000 $m^2$, for example, then a 100 g application would require 1000 x 100 = 100,000 g or 100 kg of lime.

Agricultural lime is usually sold in 20 kg bags, and can be applied by hand after cutting the bags open. Wear gloves and a spray-painting mask or similar protective gear to avoid breathing in the lime dust.

**Figure 8. Application of lime**

Spread the lime over the damp earth in a thin layer that covers the entire pond bottom. Close the pond water outlet so that rain or seeping water does not wash the lime out of the pond. Allow the lime to settle for 2–4 days before filling the pond with water. This will allow time for the lime to soak into the soil and condition it properly.

The following pest treatments may also be applied during this period:
Teaseed cake. This is a residue of the fruit of a plant (Camellia sasanqua or C. semiserrata) after the fruit oil has been extracted. The byproduct contains saponin, which is poisonous to fish. At a concentration of 10 ppm, saponin causes fish to die in a few hours. The general dosage is 1 kg of teaseed cake per 15 $m^2$ of pond area. Teaseed cake in powder form is first soaked in water until dissolved, then the solution is evenly spread over the pond bottom.

Rotenone. This is extracted from the roots of a plant (Derris uliginosa or D. elliptica) and may be available locally. The extracted solution contains about 25% rotenone, which is poisonous to fish. The recommended rotenone concentration for pond clearing is 2 ppm. The rotenone solution is first diluted 10–15 times with water and then evenly spread over the pond bottom.
When the pond is filled, if the pH of the water is too high it can be improved by "ageing".

This means filling the pond with water 2–4 weeks before stocking to allow natural biological processes to adjust the pH.

### 4.10.30 Applying fertilizer

Fertilizer supply nutrients that encourage the growth of phytoplankton in the pond. (Phytoplankton consists of microscopic plants, mainly algae, that float in water.)

Zooplankton and bottom-dwelling (benthic) animals such as tiny shrimps, worms and water insects feed on phytoplankton and decaying plant material so they also grow well if fertilizer is added. Ensuring a good density of plankton also provides cover for the prawns and prevents the growth of rooted aquatic plants. Prawns feed on this natural food as well as on the supplementary feed added to the pond.

When no pests remain in the pond, and lime has been applied to counteract any acidity in the pond soil, fertilizers can be broadcast over the pond bottom. Less phytoplankton is needed in a prawn pond than in a tilapia pond. Unlike tilapia, prawns do not eat phytoplankton directly, though they do benefit from eating the zooplankton and bottom-dwelling organisms that feed on phytoplankton. A more important reason for encouraging a moderate phytoplankton "bloom" is that prawns prefer water that is murky enough to screen out sunlight.

In prawn culture, the use of fertilizer requires a delicate balance (too much fertilizer will result in heavy plankton blooms that will reduce DO levels during the night and could kill the prawns). Two main types of fertilizers are used:

- natural organic fertilizers such as manure from chickens, cows, goats, pigs or horses
- manufactured or inorganic fertilizers such as urea, TSP and superphosphate.

Organic fertilizer is cheap and should be readily available in rural areas. However, it takes time to collect, is smelly, and some people may not buy the prawns because they think they are being fed on manure.

Inorganic fertilizers may be either single element fertilizers that contain a single nutrient like ammonium sulphate, urea, or phosphorus; incomplete fertilizers that contain two nutrients such as nitrogen and phosphorus; or complete fertilizers that contain more than two nutrients, such as nitrogen (N), phosphorus (P) and potassium (K). Inorganic fertilizers are easy to use, do not smell and are always the same strength. However, they are more expensive. If there are several choices, the grower's experience over time will indicate which fertilizer gives the best value for money. Chicken manure can be broadcast over the pond bottom at the rate of 1000kg/ha. Inorganic fertilizer, at the rate of 100–200kg/ha (Table 3), can also be applied in combination with chicken manure.

**Table 1. Fertiliser application rates**

| Type of fertilizer | Amount to use per $m^2$ |
|---|---|
| Urea | 6 g |
| TSP | 3.5g |
| Superphosphate | 7g |
| Chicken manure | 15g |
| Cow manure | 70g |
| Pig manure | 50g |

Always measure the quantity of fertilizer required. If there are no weighing scales, use a

canned-fish tin as a scoop to measure fertilizer, using the quantities shown in Table 4.

**Table 2. Fertilizer quantities measured using a fish tin**

| Fertiliser | Small fish tin | Large fish tin |
|---|---|---|
| Urea | 180 g | 315 g |
| TSP | 250 g | 480 g |
| Superphosphate | 250 g | 480 g |

There are two ways to apply organic fertilizers. For fast action to quickly stimulate plankton bloom (for example, when the pond is first filled with water), dissolve the manure in a drum of water, then pour it into the pond. Inorganic fertilizers can also be dissolved in a bucket of water for faster action. TSP needs warm or hot water to dissolve properly.

For slower action (to slowly release nutrients over time to maintain a steady plankton bloom), put manure or inorganic fertilizer granules into sacks, tie the top, and leave the sacks floating in the pond (Fig. 12). Take the sacks out again if a Secchi disc reading indicates that the bloom is getting too heavy. A Secchi disc is a simple way of measuring water transparency (see section 6.6.2).

If the pond water is not very green (Secchi value is greater than 35–40 cm) then add a little more fertilizer. If the pond water is too green (Secchi value is less than about 25 cm) then take the fertilizer sacks out of the pond, or open the water inlet for a short time to flush the pond. Fertilizer rates may be increased or reduced depending on how well the plankton grows.

Fertilizer should be stored in a dry, airy place that is well protected from rain. To keep inorganic fertilizer from getting damp, which will make it go hard, store the bags on wooden pallets, not directly on cement or dirt floors.

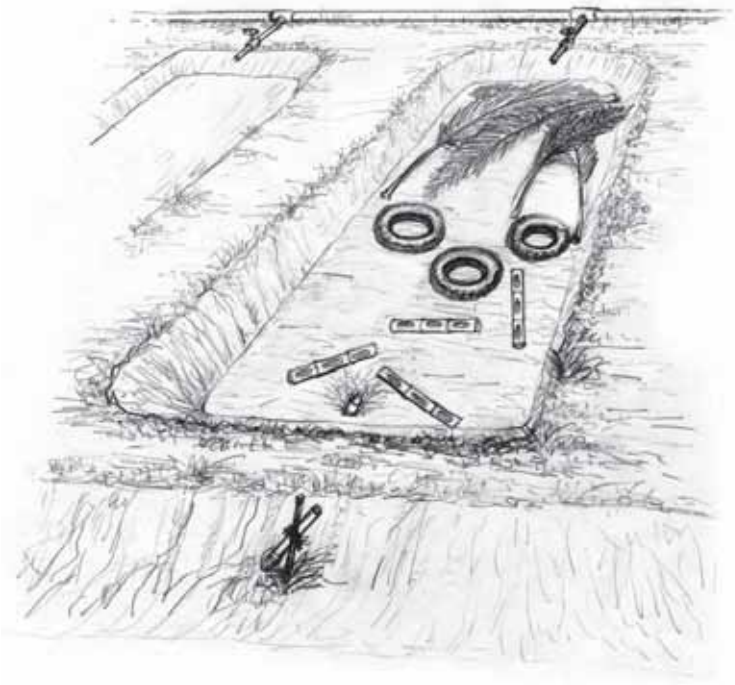
*Figure 9 : Sack of fertilizer floating in pond.*

**4.10.30 Provision of shelters or substrate in ponds**

Shelters consist of objects that are placed in the pond to provide additional habitat or surface area for the prawns (Fig. 13), which are bottom-dwelling organisms. This allows a higher stocking density and improves growth and survival. In addition, it helps to reduce competition for space and thus aggression. Shelter materials can consist of sawn-off PVC pipe (length 50 cm, diameter 10 cm, 2000–2500 pieces per hectare), coconut fronds (400/ha), lengths of bamboo with holes in them, or PVC barrier fencing. These materials should be placed horizontally on the pond bottom, except for the PVC fencing, which should be suspended vertically in the water. The surface area of the sides of the barrier fencing should be equivalent to at least 40–50% of the area of the pond

bottom. Use bamboo or wooden stakes to support the PVC fencing in the water.

**Figure 10 : Examples of materials used for shelter in ponds.**



### 4.10.31 Filling the pond

After applying fertilizer and putting the shelters in place, the pond should be filled gradually. The volume of water required to fill the pond should be estimated before filling to ensure that there will be no effect on other farm operations. The incoming water should fall on a flat surface, such as a board, to avoid disturbing the soil at the bottom and sides of the pond. Ensure that screens are fixed on the inlet, outlet and overflow pipes to prevent predators entering and later escape of prawns. The water depth in the pond should range from 80 to 100 cm during the grow-out period.

Water quality influences the growth rate of the prawns and therefore water exchange is particularly important. A good water exchange program is necessary. A continuous water flow-through system is recommended to:

- maintain good DO levels
- maintain pond water depth to compensate for seepage, evaporation, and other losses
- flush out wastes and toxic materials such as ammonia.

Reserve water must be available to allow at least 10% of the pond water volume to be replaced at any time. The water flow-through system may be stopped during rainfall.

### 4.10.32 Stocking with post-larvae

After the pond has been prepared and filled, leave it for 5 to 10 days to allow enough time for plankton to bloom. It is then ready to be stocked with post larvae. The post larvae should be healthy and active. If juveniles are stocked, they should be of similar age and size.

In Fiji Islands, PL are put in ponds 2–10 days after metamorphosis (15–20 mm long, 0.015–0.02 g average body weight). Rearing PL in tanks or nursery ponds to a size of 3–5 g is recommended as it gives better growth and survival. However, this is not the usual practice due to unavailability of nursery facilities and difficulties in managing nursery ponds and tanks.

### 4.10.33 Transport of post-larvae

If the hatchery supplying the PL is a long distance away, or on another island, the supplier will need to prepare and pack the PL carefully for transportation.

When the PL arrive, the farmer should release them into the pond as soon as possible. However, they should not be released quickly into the pond because sudden changes in water temperature or water quality can harm them. Before they are released from the bags, let the temperature of the transport water adjust gradually to the temperature of the pond water by floating the bags in the pond for 15–20 minutes (Fig. 11).
Give the prawns time to adjust to their new water conditions. Once the bags are open, splash in some pond water by hand to mix around 50:50 with the water in the bag or container (Fig. 14, middle). After 3–5 minutes, tip the bag on its side and allow the prawns to swim out by themselves (Fig. 14, bottom).

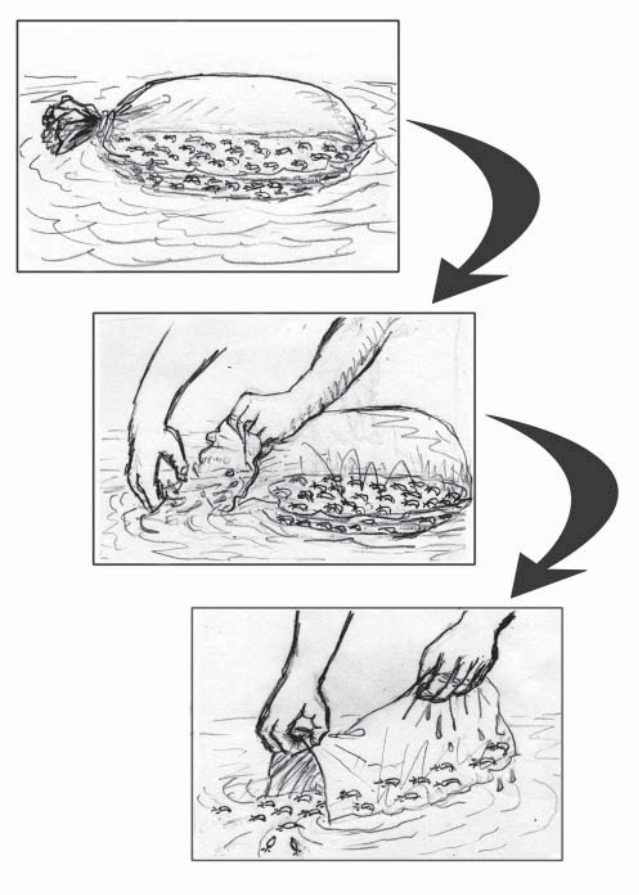


**Figure 11 - Gradually releasing prawn post-larvae into pond.**

### 4.10.34 Stocking Rate

In choosing the stocking density (number of prawns per square meter), the grower should consider the market size desired at harvest. If the stocking density is high, the prawns will feel crowded and stressed and will grow much more slowly unless conditions are managed carefully to compensate for the higher density. For example, at high stocking densities, the supply of food and oxygen usually becomes limited and thus more care and attention is required in managing the ponds — more food must be given to the prawns, and to prevent oxygen shortages and reduce accumulation of prawn wastes (which also reduce the supply of oxygen), more water needs to be exchanged to flush out some of the pond water. Aerators can be used in the pond in addition to flushing.

In Fiji Islands, the preferred market size for prawns is about 30g (head on) and this is usually achieved in 4–6 months of culture. The stocking rate ranges from 5–8 PL/$m^2$ and is reduced to 3–5/$m^2$ if juveniles are stocked. A few growers practice intensive culture with stocking densities of more than 12–20 prawns/$m^2$.

The following notes are a guide to choosing a suitable prawn stocking density for a farm:

- New prawn farmers should stock at a low density and develop technical expertise through several harvests before increasing the stocking density.
- Stock at a low density if large-size prawns are desired by the market.
- Lower stocking densities will yield larger prawns but will lower the total harvested weight and may also reduce profits.

### 4.10.35 Feeding

Prawns are bottom feeders and omnivores (eat both plants and animals). In the wild, they eat aquatic insects and larvae, worms, small snails and shellfish, other crustaceans, rotting flesh or offal from fish or other animals, grains, nuts, seeds, fruit, microalgae, tender leaves and stems of aquatic plants, and rotting plant material. They prefer animal sources of food to plant sources. Prawns are cannibalistic and also eat their own moulted shells. They locate their food mostly by smell or by touch with their antennae. Prawns benefit from natural food in the pond (plankton, insect larvae, and so on), which supplements the feed supplied by the farmer.

### 4.10.36 Supplementary feed for prawns

Prawns require a diet with a protein level of about 35–40% for the first month, reducing to 28–30% for grow-out from the second month to harvest time. Pellet feeds formulated for tilapia, which have a crude protein level of 25–30%, can also be used for prawns. For intensive prawn culture, feeds with higher protein levels and with added vitamins and minerals are used. Good prawn feeds contain 30–35% protein, 2–10% fat and 4–12% fibre.

Most formulated diets come in powder, meal, crumble or pellet form. During the early stages, the particle size of the feed should be small, increasing gradually as the animal grows. Powder or meal forms are normally used for PL and juveniles, and pellets are used for older juveniles and adult prawns.

Food added to the pond may not be eaten quickly. This means that supplementary feeds must last well in the water (at least 2–3 hours) and maintain an attractive odor.

### 4.10.37 Feeding rate

The amount of feed offered should be regulated according to the total weight of all the prawns in the pond (biomass), as well as observations on daily feed intake. The feeding rate will be higher at first, reducing as the prawns grow bigger. Other factors that affect the feeding rate are the health of the prawns, water quality, oxygen level, temperature, ammonia content and feed particle size.

During the early stages of growth, prawns may be fed close to 30–50% of average body weight per day to promote fast growth. This is more than the PL can consume, but the uneaten food acts as a fertilizer to build up plankton density. When excess feed is added to the pond there may be no need for organic fertilizers. Overfeeding is continued until the phytoplankton density gives a Secchi disc reading of between 30 and 35 cm.

The feeding rate can be reduced gradually to 5% of total body weight by the end of the second month.

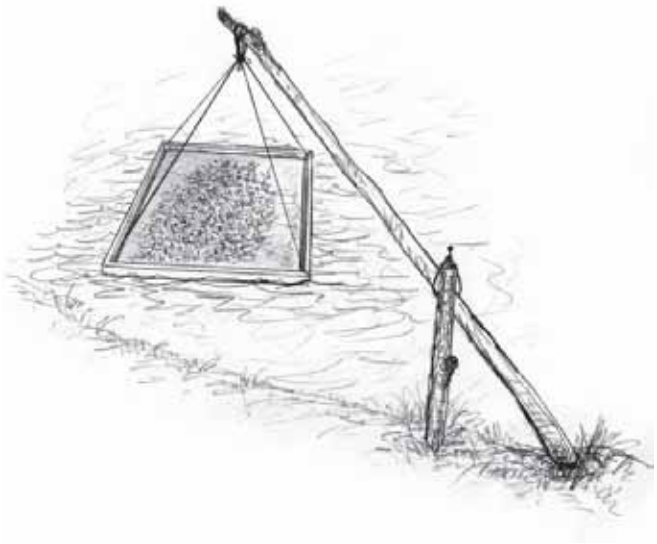
### 4.10.38 Feeding frequency

Generally, it is better to feed 2–6 times a day, with more feed given during evening hours. Observation and experience help the farmer to develop the best feeding schedule. During their early stages of growth, the prawns are growing fast and have to be fed several times

a day. It is advisable to start feeding six times a day and as the prawns grow, reduce the number of feeds per day. Adult prawns may only need to be fed twice a day with 70% of the feed ration given in the evening.

### 4.10.39 Method of feeding

Spread the feed all over the pond because the territorial behavior of the prawns means that they do not venture very far in search of food. Because prawns are most active at night, most of the daily feed ration (about 70%) should be given during the evening hours.



Use a feeding tray to check how much feed the prawns are taking (Fig. 15).

Put a couple of handfuls of feed on the tray when broadcasting feed into the pond and lower it into the water. If most of the feed is still left on the tray at the next feeding time, reduce the amount of feed. If the prawns have eaten all the food on the tray, they are hungry and need more feed or more frequent feeding.

**Figure 12. Feeding tray before it is lowered into the water**

### 4.10.40 Summary of feeding guidelines

- Feed every day or at least six days per week, unless low DO arises. In this case, reduce the amount of feed given.
- Feed six times each day when the prawns are young.
- Feed according to the total weight of prawns in the pond. Increase the amount of feed as prawn weight increases. Sample the prawns every three weeks to calculate the weight increase and feed ration required.
- Prawns are active during the evening (they are nocturnal), so feed 70% of the ration in the evening.
- Weigh out the food to be given at each feeding time.
- Feed along the length of the pond dyke.
- Feed slowly; do not just "dump" the feed in at one place.
- Feed with the wind behind so that any dust from the feed blows into the pond and can also be eaten.
- Do not overfeed (see section 6.7.1). Ensure prawns are feeding properly. Check the pond bottom for any uneaten and rotting feed.

### 4.10.41 Daily maintenance

The condition of the ponds and the behavior of the prawns must be checked daily. There are fewer margins for error with pond water quality for prawns compared with tilapia. Tilapia are much hardier and can tolerate poorer water conditions than prawns.

The daily tasks required in managing a pond include checks on:

- pond water level — should be at least 80 cm deep
- prawn behavior — are they hiding or gathering at pond edges?
- condition of prawns — are there dead prawns floating in the water?
- water inlets and outlets — ensure mesh screens are in place and free of rubbish
- water color and transparency
- growth of aquatic weeds, dyke erosion and damage to waterlines

- temperature, DO, pH, and salinity if the pond has brackish water.

The daily observations should be recorded in a notebook or pond logbook.

### 4.10.42 Plankton

Plankton consists of microscopic organisms that live in the pond water. They include plants (phytoplankton), animals (zooplankton) and bacteria. When there is enough plankton, it makes the water murky, allowing the prawns to hide and feel secure. Zooplankton is also a natural food for the prawns. When there is enough phytoplankton in the water to give it a green or brown color, the water is said to have a plankton bloom.

Phytoplankton adds oxygen to the water during the daytime, but during the night it stops producing oxygen and starts using it. The plankton bloom can use so much oxygen during the night that prawns may die if the plankton bloom is too heavy. DO is at its lowest in the early morning (before dawn), so this is the most dangerous time for the prawns.

The bloom can be controlled by increasing plankton growth by using fertilizer, or reducing plankton by adding new water and thus washing some of the plankton out of the pond.

### 4.10.43 Water transparency

Water transparency can be measured by a Secchi disc (Fig. 13), which can be made by nailing a white plastic disc (for example, an ice-cream container lid) to the end of a metre-long stick marked with a centimeter scale. The disc is held underwater at the depth where it just disappears from view, and the depth at which it vanishes is read off the scale. Ideally, the plankton density should be such that a Secchi disc immersed in the water just disappears from view at a depth of 35 cm. If the Secchi disc disappears at a depth of 25 cm or less, the water is too murky or green with phytoplankton and water should be added to the pond to wash some of it out.

A simpler method of making this measurement is to put your arm down to the elbow in the water. If you can see the tips of your fingers, the water is too clear. If you cannot see your palm, then the phytoplankton density is too high. If the bloom is too heavy (Secchi value of less than 25 cm), perhaps due to hot dry weather with a lot of sunshine, the phytoplankton will use large amounts of DO at night. This can cause die-off of both prawns and phytoplankton. In such cases, the color of the water will change from green to brown and even to black. Prawns will die at night from lack of oxygen and will be seen floating near the water surface. To avoid this, flush out the pond with water from the inlet. If there is a shortage of water and the pond cannot be flushed, then reduce the amount of feed being given or stop feeding the prawns, stop adding fertilizer, and take any fertilizer bags out of the pond. If these actions do not fix the problem, carry out a harvest.

### 4.10.44 Dissolved oxygen (DO)

Like all living things, prawns need oxygen to live. Oxygen dissolves into pond water in several ways: slowly from the air; from phytoplankton in the water during the daytime; by the action of waves created by wind; by adding new water to the pond; and by rain water splashing on to the surface of the water.

Most prawn farms use water exchange to keep DO levels high. Maintaining other water quality parameters is also important. Where the topography of the site allows, the DO levels of the incoming water can be enhanced by letting water fall into the pond from above the water level, thus creating more movement of water.

In Fiji Islands, aeration equipment (such as a paddle wheel) is not used in grow-out ponds. There is also very little equipment for use in an emergency, for example, in times of low oxygen. However, permanent water exchange or a good flow rate is now recommended because growers want to maintain higher stocking densities.

It should be noted that aeration is needed to increase the water quality necessary for maximum growth and survival if farmers want to increase the stocking density of grow-out ponds. In addition, aeration or pumped water is required for emergency use, especially after a partial harvest and long periods of cloudy weather.

Phytoplankton produces oxygen during the day and uses it at night, causing oxygen levels to be higher in the daytime and lower at night. For good growth of prawns, the DO level should ideally be above 3 mg/L in the early morning before dawn when DO levels are at their lowest. If the measured DO is too low, or if dead prawns are seen, some of the pond water should be flushed out by adding or pumping in large amounts of fresh water. This is important to maintain DO levels and should be carried out both at night (when DO levels are naturally low) and also in the daytime, when they can become low at the pond bottom where most of the prawns live.

### 4.10.45 Temperature

Prawns are cold-blooded animals and their body temperature depends on the temperature of the water. Below 22°C, prawns are less active and feed less. In cooler months, reduce the water depth and cut back shade around the pond to allow the water to be warmed by sunshine during the day.

### 4.10.46 Sampling

Every three weeks, a sample of 30–50 prawns should be caught from the pond and weighed, so that the amount of supplementary feed needed to keep pace with their growth can be calculated. To calculate the daily feed ration (DFR), which is the amount of feed to be given to the prawns in the pond each day, the total number of PL stocked in the pond initially must be known. The average body weight (ABW) of the prawns must also be estimated.

Various methods can be used to catch a sample of prawns for weighing, for example, a cast net or seine net. It is important to use a method that does not disturb the pond bottom excessively.

It is best to take samples in the cool of the morning or evening. The prawns should be weighed as soon as they are caught, then released. They can be weighed individually or altogether.

To weigh juveniles, two buckets are required, one with holes and one to hold water (Fig. 17). The bucket with holes is weighed, then placed in the second bucket and filled with

water. The prawns are netted and transferred to this bucket. After the prawns have been added, the bucket with holes is lifted gently, allowing the water to drain into the second bucket. Allow time for the water in the bucket to drain as much as possible while gently shaking the bucket. Weigh the bucket using a spring balance that can weigh accurately in the 0–1 kg range, or a top-loading balance. Use a top-loading balance to weigh individual juvenile prawns or prawns that have been in the pond for two months.

The weight of the prawns in the bucket is the difference between the weight of the empty bucket and the weight of the bucket containing the prawns. The ABW is calculated by dividing the weight of the sample of prawns by the number of prawns in the sample:

ABW = Total weight of a random sample of 30–50 prawns Number of prawns in the sample

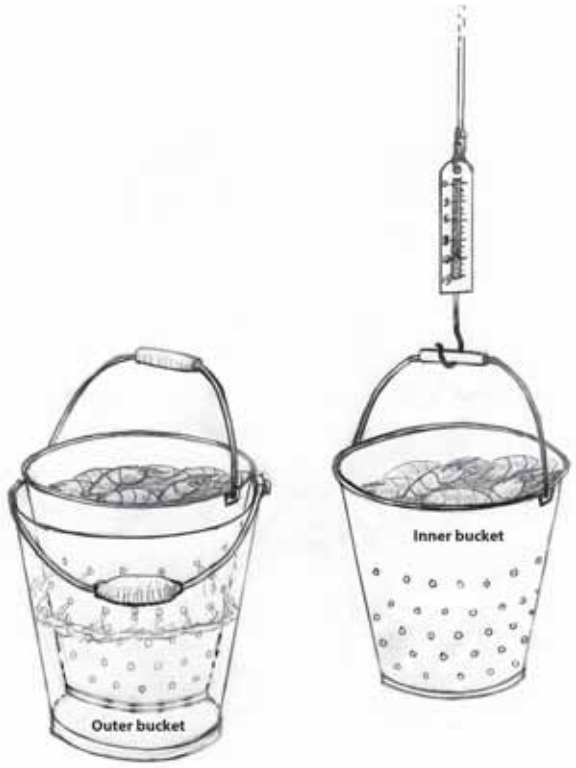



**Figure 14. Weighing a sample of prawns**

**4.10.47 Daily feed ration (DFR)**

The amount of food given daily is calculated from the amount of food required by one prawn each day (feeding rate per day), expressed as a percentage of prawn body weight. The feeding rate varies depending on the size and age of the prawn. Table 5 provides a guide for feeding different sizes of prawns using high-quality formulated feed.

**Table 3. Guide for feeding prawns at different sizes**

| Prawn size | Feeding rate per day | No. of feeds per day |
|---|---|---|
| PL | 20–50% | 4–6 |
| 2–3 g | 10–15% | 4 |
| 4 g to adult | 5% | 2–3 |

The daily feed ration (DFR) is calculated by multiplying the estimated total weight of prawns in the pond (number of PL stocked in the pond initially multiplied by the ABW of the prawns sampled) by the feeding rate appropriate for the prawns at their current size.
DFR = feeding rate per day x ABW x total number of prawns

The total daily amount of feed is then divided into several feeds a day. For example, for a daily feed amount of 2 kg for small prawns being fed four times a day, divide 2 kg by 4 feeding times. In other words, give 500 g of food at each feeding time, four times a day.

Worked example of daily feed ration (DFR)

**Worked example of daily feed ration (DFR)**

What will be the total amount of food needed each day by 5000 PL with an average body weight (ABW) of 0.02 g?

Total weight of PL in the pond = 5000 PL x 0.02 g = 100 g

At a size of 0.02 g, the PL should be fed at a rate of 20–50% of their body weight daily. If we take a value of 50%, then:

DFR = 0.50 x 100 g = 50 g of food per day. PL of 0.02g should be fed 4 times per day, so: Amount of feed at each feeding time = 50/4 = 13g feed

### 4.10.48 Total feed requirement

The total feed requirement (TFR) is the total amount of feed needed for a whole pond cycle from stocking to harvest. The TFR is found by calculating the amount of feed given from one sampling date to the next (by multiplying the DFR by the number of days that a particular DFR was given), then adding together the amounts calculated for each period between samplings.

Recording this in the logbook will give operators a guide on how much feed to buy in future and how much money should be set aside to buy feed during a pond cycle.

Worked example of total feed requirement (TFR)

A pond was stocked with 5000 juvenile prawns at a size of 1g. At the initial feeding rate of 20%: DFR = 0.20 x 5000 x 1g = 1000g of food per day

After 21 days, the prawns were sampled and the ABW was 5g. Assume that the number of prawns is reduced to 4800, a mortality rate of 2% over the 21 days. At the new feeding rate of 5%:

DFR = 0.05 x 4800 x 5g = 1200 g of food per day
After another 21 days, prawns were again sampled and ABW was 10g. Assume there are now only 4700 prawns. Still at the feeding rate of 5%:

DFR = 0.05 x 4700 x 10g = 2350 g of food per day
The prawns were fed for another 21 days before sale. What is the TFR over this period? TFR = (DFR x 21 days) + (DFR x 21 days) + (DFR x 21 days)
= (1000 g x 21) + (1200g x 21) + (2350 g x 21) = 21,000 + 25,200 + 49,350
= 95,550 g

A total of 95,550 g (95.5 kg) of prawn feed was fed over this 63-day grow-out period.

### 4.10.49 Food conversion ratio

The food conversion ratio (FCR) is the amount of food used to produce one kilogram of fish. Calculating the FCR shows whether the prawns are being overfed or underfed. For example, if prawns are fed according to the suggested guidelines but seem to be growing rather slowly and the FCR value is low, then this indicates they need more food to speed up their growth. On the other hand, a high FCR value can indicate overfeeding.

The FCR over one pond cycle is calculated from the TFR and the total weight gain (TWG) of the prawns. The TWG is the difference between the total weight of prawns harvested and the initial weight of PL or juveniles stocked. It can be calculated from an estimate of the ABW at the time of harvest multiplied by the number of prawns harvested, or taken directly from records of prawn sales.

TWG = (final ABW x number) – (initial ABW x number) FCR = TFR
TWG

Note: an FCR value of 3 means that 3 kg of feed was needed to produce 1 kg of prawns.

For semi-intensive culture, FCR values of 2.5–3.5 are considered good. In intensive systems, higher FCR values of 3.0–3.5 are likely because there will be very little natural food available in the pond.

If the FCR value is very high (for example, 5), then it is likely that not all the feed is being eaten, and so some is being wasted. Another explanation is that the feed is of low quality, so the prawns have to eat much more of it to grow.

### 4.10.50 Harvesting

Prawns can be harvested 3–5 months after the pond is stocked with PL and juveniles. Usually, pond-reared prawns reach a size of 25–50 g within 4–6 months, depending on the stocking rate, feed quality and quantity, water temperature and DO level. The exact time chosen for harvesting is determined by factors like the preferred market size for prawns and by opportunities to achieve good sales volume and prices.

All the requirements for harvesting must be prepared in advance including aeration, inflow of clean water, holding tanks, buckets, seine nets and scoop nets. The substrate or shelters should also be taken out of the pond to avoid getting them tangled in the seine net.

Pre-planning is needed to ensure that the quantity of prawns seined can easily be sorted or taken out without causing unnecessary stress to small prawns. Many small prawns die when there are too many prawns in the seine net or when the net full of prawns is lifted out of the water.

### 4.10.51 Partial and complete harvesting

All harvesting operations should be carried out as early as possible in the morning when it is cooler to avoid high temperatures and low DO levels, which will result in numerous prawn deaths before harvesting is completed. Basically, two types of prawn harvesting are practiced: (1) partial harvesting, sometimes referred to as cull harvesting, and (2) complete harvesting, sometimes called drain harvesting.

### 4.10.52 Partial harvesting

During a partial harvest, market-size prawns only are caught at intervals of 2–3 weeks after 3.5– 4.0 months of stocking. Partial harvesting is usually carried out by pulling a seine net through the pond. A cast net may be used if only a few kilograms of prawns are required.

In rectangular ponds, the seine net is usually held at each end and pulled lengthways down the pond. The bottom of the seine (lead line) must be kept on the bottom of the pond by pressing it down by hand in shallower water or by using the feet in deeper ponds. The float line should always be kept on the surface of the water to prevent prawns escaping. Where ponds are irregular in shape or too wide to harvest by pulling each end of the seine net, only a portion of the pond is seined. This is usually done by keeping one end of the

seine net stationary and pulling the other end around in a circular way or by cutting the corner of the pond.

The number of people required to pull a seine net depends on the size of the pond to be seined. In a 25 m-wide pond, it is preferable to have two to three people on each bank pulling the lead and float line, and six to ten people inside the ponds, pressing the lead line on to the bottom of the pond, keeping the float line above the water surface and at the same time pulling it (Fig. 18). The net should be set up at the deep end of the pond and dragged along the pond towards the shallow end (inlet end). The prawns can then be sorted out at the inlet end where there is plenty of clean water coming into the pond.

Once the net has been pulled through, the prawns should be gathered into one area of the net. There, they must be kept under water while clean water is allowed to pass through them to clean them and ensure high survival of undersize prawns.

Market-size prawns can then be selected and transferred into a holding tank or other suitable container. Undersize prawns should be returned to the pond or put into another pond. This operation should be carried out quickly to avoid prawn deaths.

After partial harvesting has been carried on several occasions (and prawns have been reared for 7–8 months), seine the pond 3–4 times while reducing the water level. Then, completely drain the pond and collect the remaining prawns. The undersize prawns can be kept in aerated containers or transferred immediately into another pond. Further details on how to handled harvested prawns are given below (section 6.8.2).

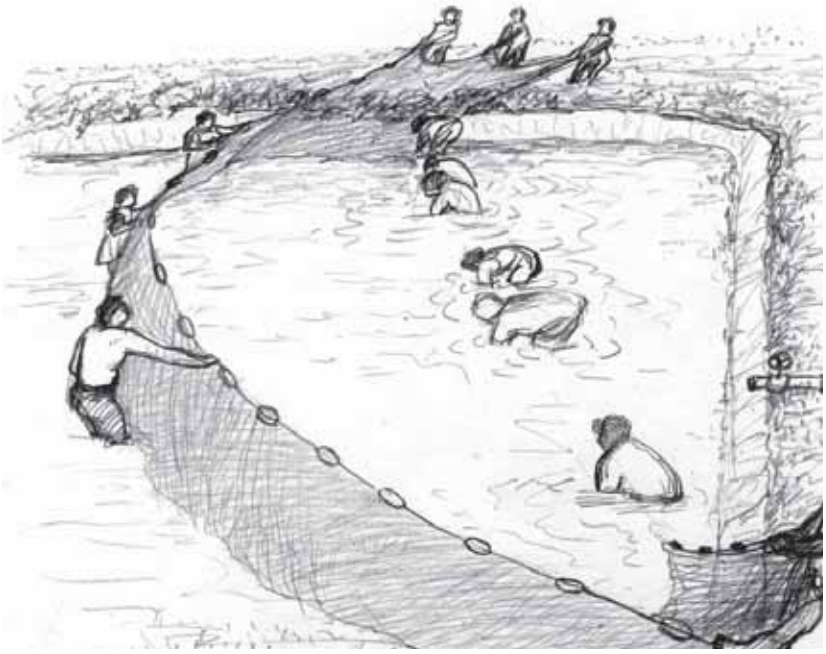


**Figure 15. Using a seine net to harvest prawns**

*Complete harvesting*

A complete harvest is usually carried out after 4–5 months of grow-out. The prawns are caught by multiple seining (as in partial harvesting) while the pond is draining. When the pond is almost empty, the remaining prawns can be collected by hand and by scoop nets. Important details on how to handle harvested prawns are given below (section 6.8.2).

### 4.10.53 Handling of harvested prawns

Special care and attention is required to minimize damage to the prawns, and ensure they stay in good condition and keep as fresh as possible.

The prawns should not be allowed to die from asphyxia simply by leaving them out of water. The harvested prawns should be washed immediately and killed in a solution of water and ice. The prawns should then be transferred into suitable containers

(Fig. 19) with alternate layers of ice and prawns, with ice as the first and last layers.

**Figure 16. Prawns are placed in suitable containers after harvest**

When the harvesting is completed, the prawns can be sorted into different sizes to suit market demand (large: over 20g, and small: 15–20 g) before being weighed and packed into 1–2 kg plastic bags. The prawns can be refrigerated for a short period at 0°C and sold as fresh prawns within 3–5 days of harvest.

If the prawns are not going to be sold as fresh prawns, then they must be frozen immediately. The recommended freezing temperature is below minus 10°C (ideally between minus 20 and minus 30°C).

### 4.10.54 Harvest records

Farmers should record all the details of each harvest by writing down the number, weight and value of the prawns (including those harvested for family use). This includes:

- how many prawns were put in the pond
- how many were harvested
- total weight of all the prawns harvested
- value of the prawns

Farmers can carry out the simple calculations below to check the overall yield:

(a) Survival rate = number of prawns harvested, divided by number of prawns put in pond, times 100

For example, if you stocked 1000 prawns and harvested 800:
800 prawns divided by 1000 prawns x 100 = 80%. A good survival rate is 80% or more.
(b) Average weight = total weight of prawns harvested, divided by number of prawns harvested For example, if you harvested 500 prawns and their total weight was 15 kg:

15 kg divided by 500 prawns = 0.03 kg or 30 g. This is about how much one prawn weighs. Some will weigh a little more, others a little less.

Usually, in cool water ponds in the Fiji highlands, an average weight of 25 g or more and a survival rate of 80% would be considered a very good result. In lowland ponds with warmer water, for example on the Navua flats, an average weight of 30–40 g and survival rate of 80% would be considered good.

(c) Number of prawns in one kilogram = total number of prawns harvested, divided by the

total weight of all the prawns

For example, if you harvested 600 prawns and they weighed 20 kg: 600 prawns divided by 20 kg = 30 prawns/kg. Like the average weight, the number of prawns per kilogram differs according to growing conditions. The following results would be considered good:

- Highland area with cooler water: 50 prawns/kg
- Lowland area with warmer water: 25–30 prawns/kg

### 4.10.55 Marketing

For marketing, prawns can be graded according to size, packed in 1kg or 2kg plastic bags, kept on ice and transported to market. They can also be sold to wholesalers. There is usually higher demand for larger prawns (in Fiji, 20–30g, or around 30–40 prawns/kg) and they fetch almost twice as much as smaller prawns. However, there is still good demand for smaller prawns (10– 15g or around 60–100 prawns/kg).

To get the best prices, timing of the harvest and preparation and presentation of the prawns are all important:

- Plan a harvest before special holidays such as Christmas when there may be high demand for prawns.
- The prawns should look and smell very clean and fresh.
- Make sure the prawns are kept on ice while they are being transported and awaiting sale.
- If the prawns are being sold at the farm, advertise the place and date of the sale in advance along with prices per kilogram. Put up signs to direct people to the place of sale.
- As well as being sold fresh, prawns can be cooked and sold at the market or at fairs as take-away food.

### 4.10.56 Record keeping

Prawn farming is a business and good records must be kept of all expenditure and income; that is, keep records of all items that are purchased, labor costs, electricity costs, and so on, and all money made from prawn sales. This will help with budgeting and planning. For example:

- knowing how much feed and fertilizer cost for one grow-out will enable farmers to set aside the amount needed to purchase supplies for the next grow-out
- the prices charged by various suppliers of goods and services can be compared
- total profit can be calculated by subtracting expenditure from income.

(Source : Nandlal & Pickering, 2006)

# Chapter 4.11 | Tilapia Farming Practices in Fiji

### 4.11.1 SITE SELECTION

Tilapia are hardy fish and can be grown in very harsh environments. However, for successful farming it is necessary to ensure the site can provide an environment where the water quality factors can be maintained in the range known to be good for tilapia. The important factors to be checked are water temperature, dissolved oxygen, acidity (pH) and salinity.

Ideally a farmer should look at different possible farm sites, and choose one that not only meets the needs of tilapia culture but is a place where the farmer can live close by. Having the ponds near the farmer's house will give easy access for carrying out daily activities and also reduce losses to poachers. The following are the important factors for the pond site:

- Flat or gently sloping land that does not get flooded
- Water source of sufficient volume and quality, preferably at a higher level than the ponds so that water can fill the ponds by gravity rather than by pumping
- Water source preferably on land owned by the farmer
- Place for water to drain away is lower than the ponds, so that ponds can be emptied by gravity rather than by pumping out
- Water drained out will not mix with water used for domestic purposes
- Soil with enough clay to hold water
- Close to farmer's house

If gravity flow of water into or out of the ponds is not possible, the farmer will need to pump the water in or out. The cost of fuel or electricity for the pump needs to be taken into account when planning, as well as the cost of hoses and pump, or rental of pump.

If there is limited choice, then as many of the above criteria as possible should be met. For example, a farm can still succeed if water has to be either pumped in to fill ponds, or pumped out to empty them; however, the chances of success are less if both have to be done.

If there are other farmers already successfully farming tilapia nearby on similar land, then there is a good probability that the new farm will also be successful. The Fisheries Department can help with more advice on site selection if needed.

**Figure 1 - Ideal farm layout**

Once a site has been identified, there are other questions that need to be answered honestly by the farmer:

- Who owns the land?
- If it belongs to the farmer, are the necessary ownership documents available?
- If the land is owned by a clan or traditional land-owning group, does the farmer have the necessary documents showing approvals for lease, or any customary approvals that may be needed?
- Will there ever be developments upstream (e.g. pig farm, pesticide spraying, factories etc.) that might spoil the water source for the fish farm?
- Is there space to add more ponds in the future?
- Will the cost of pumping water be affordable from the fish farm income?
- How far is it to the market?
- Are the road conditions good to allow trucks to transport supplies and fish for selling?

The biggest error a fish farmer can make is to develop an area in haste and without any program of activities. Money will be wasted and operation of the project may be difficult if not carefully planned.

### 4.11.2 Water source

Water is the most important factor to consider in determining the suitability of a site, especially for semi-commercial or commercial tilapia farming. Fish will not grow unless there is enough water. Water is essential: (1) to fill the ponds for stocking, (2) to refill ponds to replace losses due to seepage or evaporation, (3) to flush the pond regularly, and (4) in emergencies, to flush out ponds if water quality gets bad so that fish start dying.

The water may come from a stream or river, spring, groundwater (well or borehole) or reservoir, surface run-off, or brackish water. The water source should not dry up in the dry season. The pond should have its own water source, and not share with a school or village that in times of drought will take priority.

The land basin that drains into the site of the pond is called the water catchment. The farmer needs to consider the size and slope of this catchment, who owns it, and what it is being used for, before building a pond. Pond water obtained from streams and surface run-off originates from the catchment. Generally a 1000m$^2$ pond should have a hectare of catchment.

If too much water drains towards the pond, spillway structures will be needed to shelter the

pond from large inflows of water after heavy storms. On the other hand, if the catchment is too small, then sufficient water levels may not be maintained during dry conditions. Achieving the proper water catchment-to-pond size ratio is one reason that technical guidance is important in building a pond.

It is difficult to provide any set rule about how much water volume or flow rate needs to be available, except that the amount of water should be sufficient to keep the ponds full all year round. In some high-rainfall areas this can be achieved with ponds that are rain-fed, with no additional water from any other sources. However, a water supply will be needed if the pond takes months to hold water after digging, or if evaporation takes out water (for example, in dry sunny areas), or for ponds dug in sandy soils that hold water poorly. A good supply of water from a stream, river, lake or canal, or from a purpose-built reservoir, is also needed if the pond has to be flushed out when water quality gets out of control especially for semi-intensive farming.

The best water comes from fast-flowing streams or rivers with rocky or stony beds. Such water is usually rich in oxygen and contains at least some nutrients. But care should be taken as streams and rivers usually contain wild fish that can get into the pond and cause problems. Wild fish can be stopped from entering the ponds by a screen over the pond water inlet.

Underground water (from a spring, well or bore hole) will not have wild fish in it, but generally water from these sources is poor in oxygen and nutrients. Water from marshes or peat swamps should not be used as it is acidic (low pH).

The water should be free from agricultural pesticides and any type of pollution. It should be clear of mud and silt.

The water can be tested to find out whether the pH, hardness and salinity values are within the range that is good for tilapia growth. If the farmer does not have access to the equipment to make these checks, this service could be requested from the Fisheries Department, or provided by a professional water analytical laboratory.

### 4.11.3 Soil Type

The farmer, with guidance from the Fisheries Department, needs to identify the type of soil at the proposed pond location, since different types of soil have differing abilities to hold water. The pond soil must have enough clay content to ensure that the pond will hold water. When clay soil absorbs water it swells and seals the bottom and sides of the pond.

Soil with clay content in the range of 20–50% clay down to a depth of about one metre is best. Soil that is too sandy will cause problems: pond banks will erode easily and water will leak out through the pond bottom. If the soil is too sandy, then either an alternative site must be chosen, or a layer of clay soil will need to be compacted over the pond sides and bottom to prevent water seepage.

There are three simple tests to check if the soil has enough clay content: the water retention test (Fig. 3), the soil ball test and the soil ribbon test (Fig. 4).

### 4.11.4 Water retention test

1. Use a spade to dig 3–4 holes 1m deep in several parts of the proposed pond site.
2. Get a bucket and fill the holes about 10–20cm deep with water.
3. Wait about 15 minutes for the surrounding soil to get thoroughly wet, then make a mark on a stick, and drive the stick into the hole bottom until the mark matches with the water level.
4. Check each hole again after an hour or so, take the new level mark, and measure how much the water level has dropped, in millimetres. If the level has dropped by 3mm/hour or less, the soil is perfect. If the water level drop is between 3mm/hr and 5mm/hr, then the soil is satisfactory. If the water level drops by more than 5mm/hour, the soil is unsuitable.

*Worked example of water retention test*

The hole is filled with water at 3.17 p.m. At 4.53 p.m. (96 minutes later) the level has dropped by 7mm.

Rate of seepage = 7mm/96min

= 7/96 mm/min

= 0.0729mm/min x 60min

= 4.375mm/hour

The water level has dropped less than 5mm/hour, indicating that the soil is satisfactory.

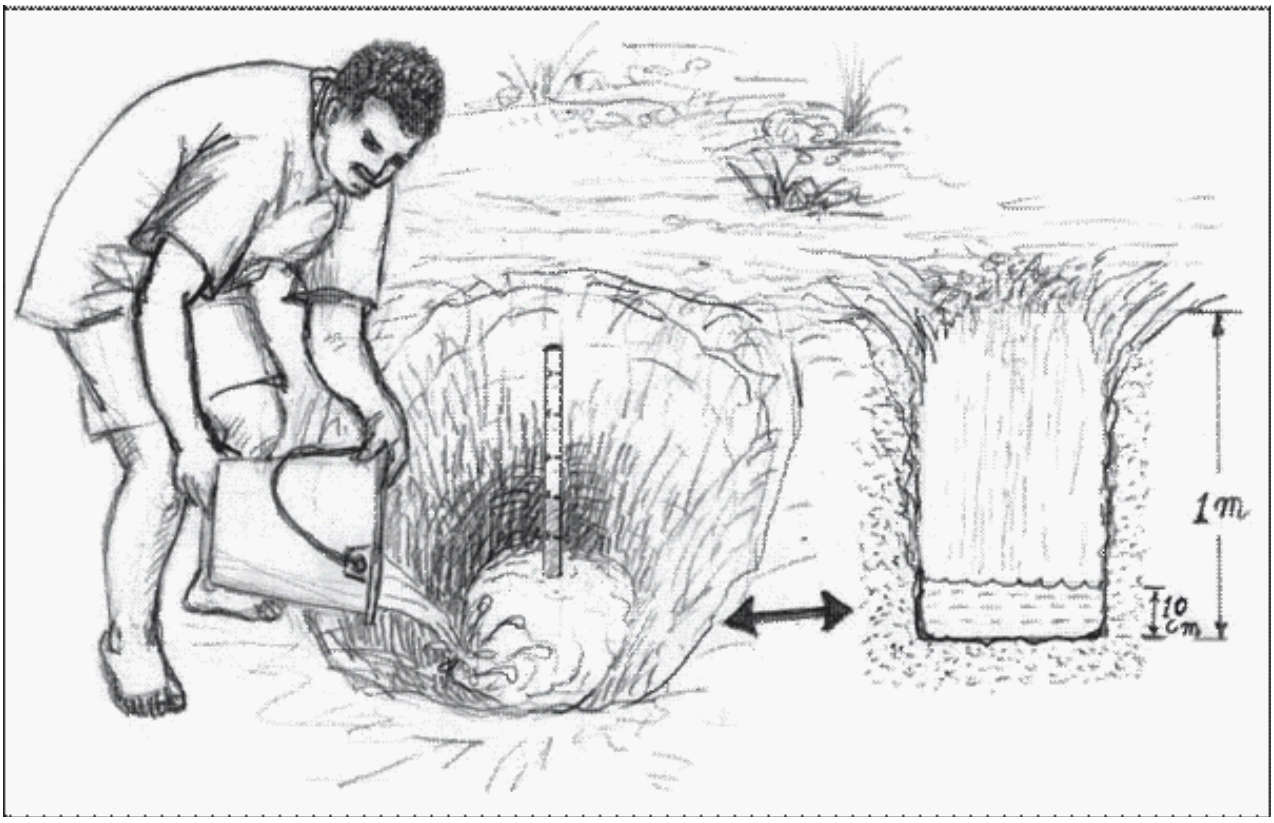



**Figure 2 : Water retention Test**

### 4.11.5 Soil ball test

1. Take some of the soil dug earlier from the bottom of the hole.

2. Wet it slightly and form it into a round ball, slightly bigger than the size of a fist.

3. Drop the ball from head height onto flat ground. If the ball retains its shape, or goes only slightly out of shape, it has enough clay content and is thus good for pond construction. A ball made from soil that is too sandy will flatten out, crack open, or even shatter on impact to the ground. Alternatively, if the ball remains intact and does not crumble after considerable handling, there is enough clay in the soil.

### 4.11.6 Soil ribbon test

1. Take some of the soil dug earlier from the bottom of the hole.

2. Wet it slightly, and attempt to mould it into a flat ribbon of earth about 3cm wide and 6mm thick. If the moist soil forms into a ribbon of these dimensions, the soil has enough clay content. If the ribbon cracks and falls apart, the soil is too sandy and not suitable for pond construction.

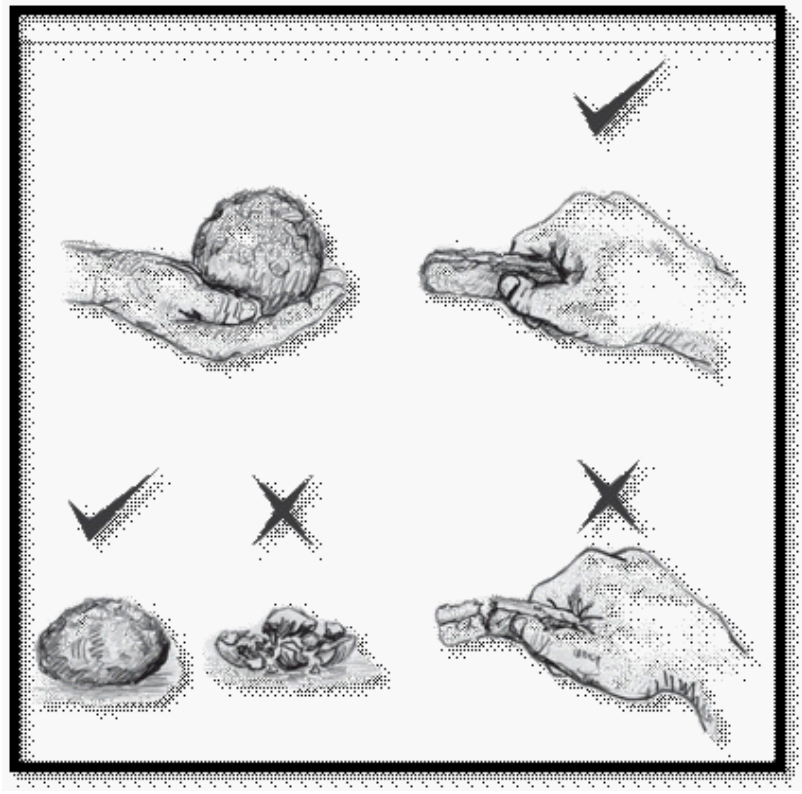


**Figure 3 : Soil Ribbon Test**

### 4.11.7 Topography

The topography or "lay of the land" is its shape: for example hilly, rolling, sloping or flat. Hilly and mountainous area should be ruled out as it is costly to move large quantities of soil during pond excavation. A moderately sloping area within a close distance of a water source is preferable.

Low-lying flat areas usually require high and large dykes (pond walls), to protect the ponds from floodwaters. Therefore in some instances soil will have to be moved in from outside the site for making the dykes. If the area is very low-lying, pond drainage will also be a problem.

### 4.11.8 Other site factors

### 4.11.9 Flood hazard

The risk of flooding has to be considered in site selection. Since floods cannot be controlled, it is important to choose a pond site that is free from flood hazard.

In order to plan to avoid flooding of the selected site, it is necessary to know the weather patterns in the locality. The rainfall records for at least the last 10 years need to be analyzed and the size of creeks, rivers and drainage canals checked to find out whether they can ac-

commodate the run-off water in the area of the fish pond. The local government weather station or people who have stayed in the area for many years will know the highest flood occurring in the area.

### 4.11.10 Wind direction

Wind plays a role in fish pond design. Strong wind generates wave actions that damage the sides of the dyke. This causes expense in maintenance of the ponds. However, the problem can be minimized with proper planning and design. For example, the longer dimension of the pond should be positioned in the same direction as the prevailing wind (see Fig.5). This will mean only the shorter sides of the pond will be exposed to wave action.

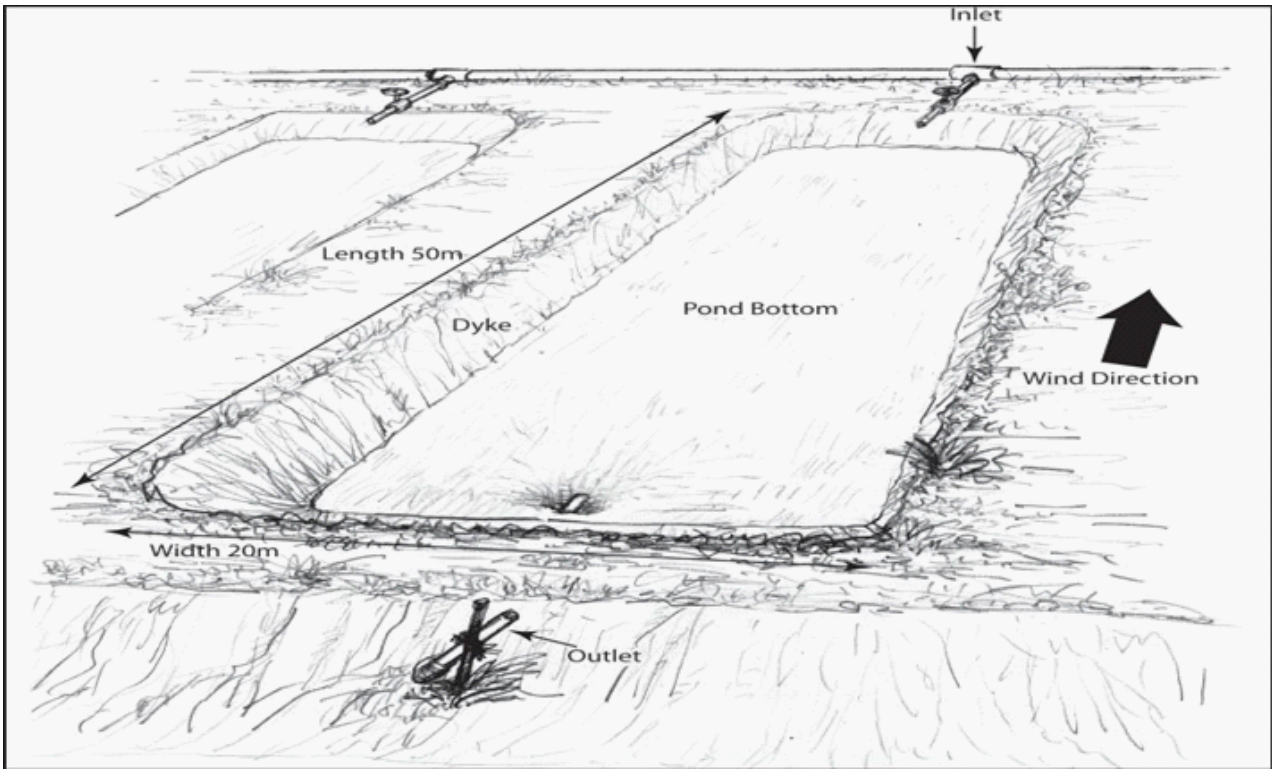



**Fig. 4. Pond features**

### 4.11.11 Type of vegetation

The type of vegetation, its density, and the size and root system of individual trees greatly affect the costs of clearing for farm development.

### 4.11.12 Availability of technical assistance

It is important to have access to technical services and advice from the Fisheries Department, or other service, and from financing institutions. Many fish farming projects in the Pacific have failed due to non-availability of quality technical services.

### 4.11.13 Sources of fingerlings

The farmer must find out about the availability and cost of fingerlings from local hatcheries.

### 4.11.14 Competing use of land and water sources

The uses made of nearby land and water have to be considered to find out whether they will have any effects on the project. Activities to assess include fishing, manufacturing industries, public utilities and recreation. Problems can arise particularly if the activities of

local people are disrupted. It is important to ensure that the project does not interfere with traditional rights of way, or interfere with other work. In addition, check for underground water pipes and power lines before allowing heavy machinery onto the site.

### 4.11.15 Supplies and equipment

Ensure that supplies and equipment needed for the project are obtainable locally. For example, fine-mesh net material for screening or fertilizer might be difficult to obtain or available only infrequently. If material has to be imported, there may be restrictions or extra costs involved.

### 4.11.16 Marketing opportunities

It is important to determine the opportunities for selling the tilapia and to plan the production activities to suit the market. In some cases, partial harvesting or harvesting only one pond at a time may suit the local market situation. On the other hand, where fish have to be shipped out to a distant market, it is better to plan to be able to harvest and market large quantities at one time.

### 4.11.17 POND FEATURES

### 4.11.18 *Layout of ponds*

It is very important to consider the layout of the ponds in relation to the topography of land, the source of water, and drainage. Also important is to allow for expansion of the fish farm at a later stage. The ponds, drainage canals and other facilities should be laid out in such a way that additional ponds can be constructed at a later stage.

A well-built pond is easier to operate, so careful attention to all the features of a pond will be well rewarded later. Below are features found in a well built pond.

### 4.11.19 Pond size and shape

Ponds of 500–2000 $m^2$ are easy to manage by household farmers. Although the number of ponds is an individual decision, a few large ponds will be cheaper to construct than many small ponds of the same total surface area.

Most farmers build rectangular ponds, though irregularly shaped and even round ponds have been built. With rectangular ponds, the long axis of the pond can be placed to take advantage of winds blowing across the pond that aerate the water. In places where high winds are a problem, the long axis can be built parallel to the prevailing wind, thus minimizing erosion from waves. In addition, rectangular ponds are more suitable for harvesting fish with a net. The length of the pond does not matter much but the preferred width is 15–20 metres, to suit the standard size of seine nets used for harvesting.

### 4.11.20 *Pond bottom*

In order for the water to drain out, the pond bottom slopes gently towards the outlet end of the pond. A minimum bottom slope of 0.1–0.2% is recommended. The pond bottom should be smooth and free from bumps and hollows, to make it easier to haul the seine nets and to catch as many fish as possible.

A catch pit or harvesting sump may be excavated around the water outlet (Fig. 6). Fish will swim into this pit as pond water drains out. The catch pit should be big enough to be able to contain almost all the fish in the pond at the time of harvesting. It also needs to have a supply of freshwater and/or aeration for the period that fish are concentrated in it.

### 4.11.21 *Pond depth*

The pond depth is usually in the range 1–2m, and often is a compromise determined by

topography, water source and soil. Ideally pond water depth should be 0.8m at the shallow end, and increase gradually to 1.2m at the deep end, with 30–50cm of freeboard (level of dyke above water, see Fig. 6). Ponds entirely dependent on seasonal rains must be deeper in order to hold water longer into the dry season, for example water depth of 1.0–1.5m.

Maintaining the right depth of water helps to regulate temperature, inhibit growth of underwater plants and maintain dissolved oxygen (DO) levels at the pond bottom, which helps the organic decomposition that provides nutrients for the growth of phytoplankton and zooplankton, microscopic organisms that will in turn provide food for the fish.

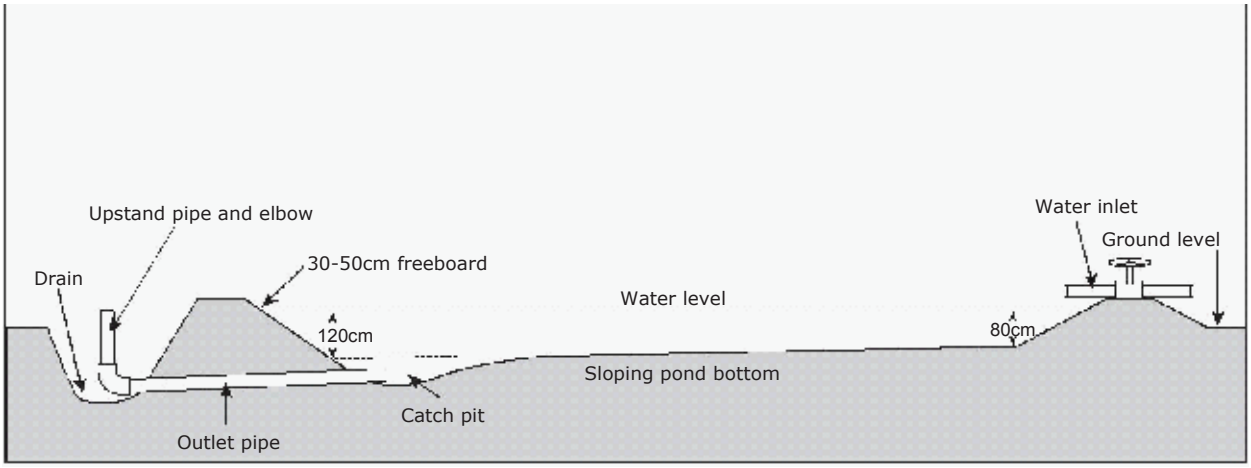


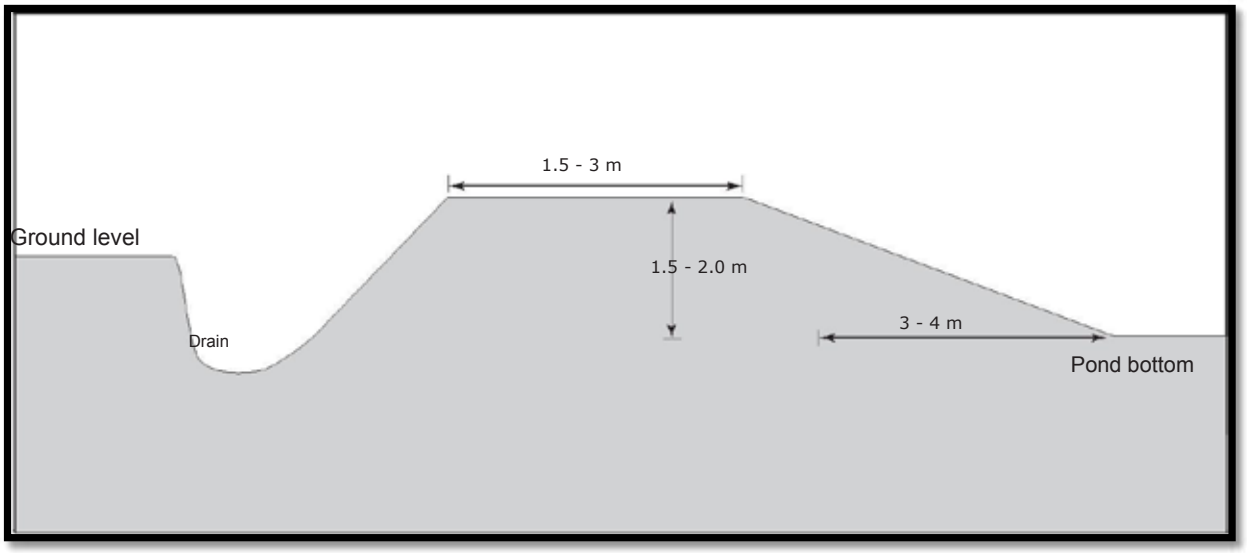

*Fig. 5. Cross-section of pond along length of the pond*

Dykes are also called dikes, banks, walls, embankments and bunds. The dyke is the part of the pond above the natural ground and is for retaining the water. It is important that the dyke walls are sloped to prevent erosion and avoid enlarging of the pond. The slope on the inside of the dyke should be somewhere from 2:1 to 3:1. The slope on the outside of the dyke can be steeper at about 1.5:1 to 2:1, but when there is a series of ponds next to one another the slopes for both sides of the dyke will be the same.

The amount of slope depends on the type of soil used to make the dyke. Dykes made of clay soils can have steeper slopes than dykes made of soft soils such as sandy loam. In hand-dug ponds the width at the top should be about the same as the height of the dyke (see Fig. 7). Where the ponds are excavated by machines, the top width is dependent on the width of the machine base (track) as well as on the type of soil and size of the pond.

The soil used for the dyke should not contain large amounts of rocks, sand, wood, grass or plants, as these will cause the dyke to leak water. Do not plant crops with big tap roots on dykes, as digging them up again will weaken the dyke.

**Fig. 6. Dyke cross-section**




### 4.11.22 Water inlet

An inlet is to let water into the pond. The location of the inlet will depend on the shape of the land in relation to the water source.

There are various types of inlets that can be used, for example PVC pipe, polyethylene pipe, galvanized pipe, open earth canal, concrete channel, pump etc. PCV pipes are expensive but are used commonly as they are easy to install, durable, and make it easy to control the water supply. A PVC pipe of 25–50mm in diameter is sufficient in most cases. An earth channel going direct into the pond is cheapest and easiest to make, but it is cumbersome to screen and to control the water supply. Water flowing through the channel also cuts into the soil where it enters the pond, causing erosion.

The flow of water into each pond must be controlled by valves (if piped) or shut-gates (if channelled). Water inlets should have a screen to keep out wild fish, twigs, leaves and other trash.

Each pond should have its own individual water supply from a central water distribution pipe or channel that brings water from the water source. No pond should receive the water outflow from any other pond. Transfer of water from one pond to another is not recommended since it means poorer water quality conditions in the next pond, and brings the risk of disease transfer. There should also not be any contact between incoming water and water drained out from ponds.

Ideally, water should be distributed to ponds by gravity, if the land topography allows it. This means the water source and inlet pipes or channels need to be at a level higher than the pond water level.

### 4.11.23 Water outlet

An outlet is to let water flow out of the pond. The outlet should be at the deepest end of the pond so that all the water can be drained out of the pond by gravity. There are several types of outlets that can be used: for example PVC pipe, siphon, or pump.

If the outlet has an up-stand pipe mounted on an elbow fitting (Fig. 8) then it can control the water level in the pond. To drain the pond, the up-stand pipe is turned on its elbow and laid down flat. At other times it is tied to a pole driven into the ground to prevent it falling over and accidentally draining the pond. A PVC outlet and up-stand pipe is more expensive, but this is the most common type of outlet used in the Pacific.

The diameter of the outlet pipe depends on the size of the pond. Usually 100–150mm is adequate for small (500–1000m$^2$) ponds. For larger size ponds, pipes with a larger diameter can be used, or several 100mm pipes. A larger diameter pipe allows for quicker drain-down of ponds during harvesting.

Outlets pipes should have a screen on the end inside the pond to prevent the fish escaping.

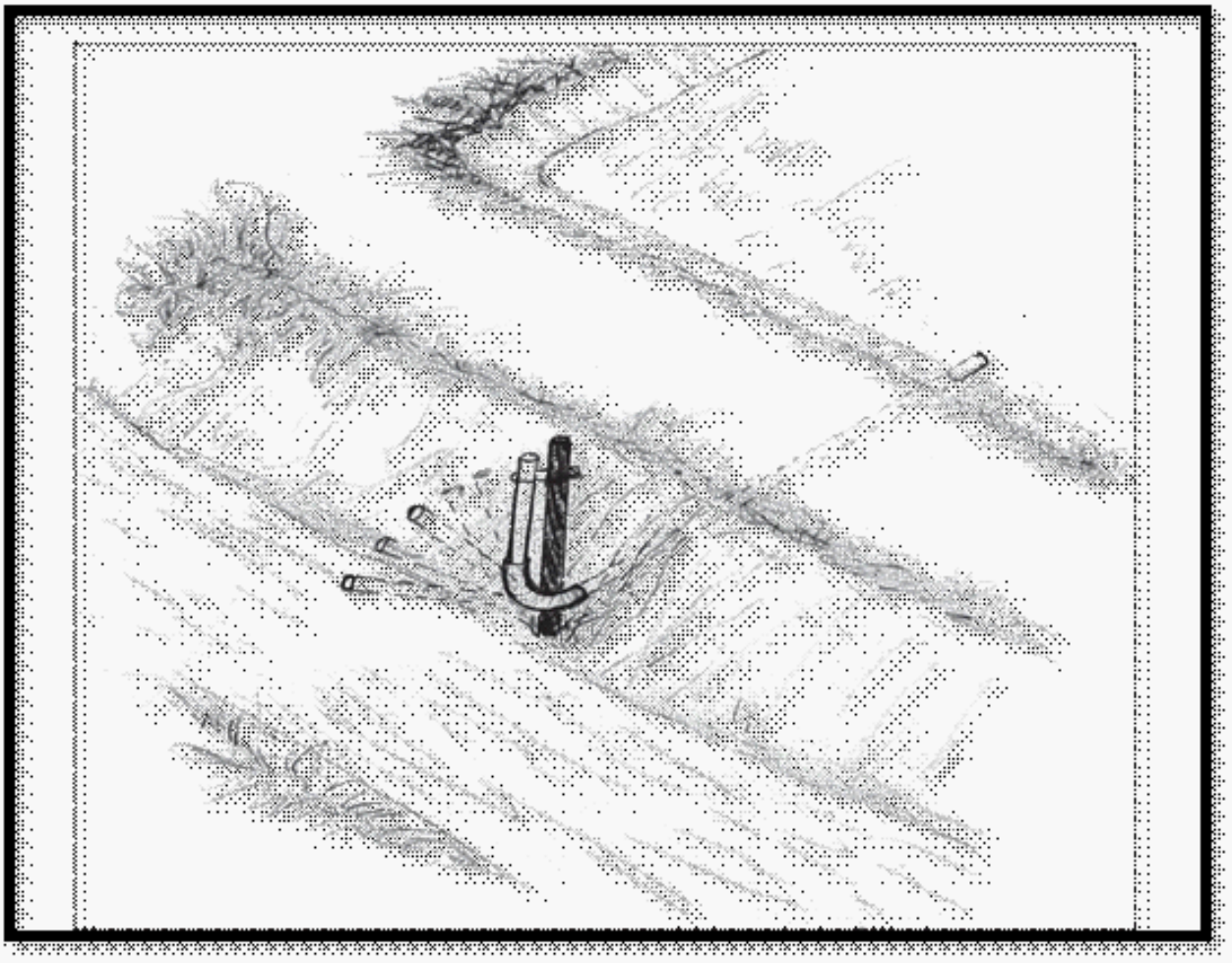


**Fig. 7: Water outlet with up-stand pipe**

### 4.11.24 Water overflow pipe

An overflow is an extra pipe to let excess water flow away during heavy rainfall. It should be placed towards the outlet side, about 20–30cm below the top of the dyke, about 20cm above normal water level. The overflow pipe should also have screen to prevent the fish escaping.

### 4.11.25 Screens

Box screens on the water inlet to prevent pest fish entering the pond are common and effective. A cloth filter on the inlet may be necessary to remove fish eggs if water is being obtained from a river or canals containing fish. Initially, 1mm galvanized or plastic mesh screen (similar to mosquito screen) is used on both the inlet and outlet. The outlet screen can be changed to a larger mesh every month as the fish grow. Screens will need to be checked regularly for clogging.

### 4.11.26 Methods of pond construction

Fish ponds are dug either mechanically using heavy equipment, or by hand labour (manually). Choice of construction methods depends on site characteristics, economic

factors and desired pond size. Heavy equipment is used for large, commercial ponds, whereas manual labour is usually used for small, family ponds.

Construction costs vary considerably when using heavy equipment. Private firms usually rent excavators, bulldozers etc. by the hour and also make contracts based on the volume of soil to be removed. Pond construction tends to be quite expensive, and transportation costs for equipment must be borne by the farmer as well. The Fisheries Department in some countries may sometimes arrange to dig ponds on a cost-sharing basis (government subsidies) but these subsidies are often difficult to obtain and arrangements are specific to each country.

Hand construction takes longer, and in some cases the costs may actually work out to be about the same as mechanical construction. If no machines are available, however, then digging by hand will be the only option for constructing the ponds. The cost of manual labour is usually based on the volume of soil dug; the price per unit volume varies from country to country and is normally agreed upon after negotiation.

Farmers often use hired labour because it is convenient and easy to organize. It keeps the money within the community and enhances goodwill among neighbours. In many Pacific Island communities, traditional relationships or kinship ties can make it possible to mobilize sufficient labour for pond construction.

### 4.11.27 Hand construction of ponds

Ponds dug by hand are generally small (100–300m$^2$). The tools required for digging include: spade, hoe, mud-scoop spade, fork, wheelbarrow and wooden mullet (ram). The steps in construction are as follows.

### 4.11.28 Marking the pond area

1. First, prepare a sketch plan of the pond area.

2. Clear the entire area of the fishpond of all grasses, trees, stumps. These could be burned or removed from the site. It is important to dig a channel or drain to allow water to drain away from the construction site.

3. To outline the dimensions of the pond, first mark the outside edge of the dyke using wooden or bamboo stakes. For example, for a pond that will have approximately 24m x 14m of water surface area, mark out a boundary measuring 30m x 20m. This will allow for a dyke around the pond that will be about 3m thick at ground level. For bigger ponds, use the same dyke-width dimension and just make the central area bigger on the plan. The corners of this rectangle can be marked with pegs, and a string can be run between the pegs.

4. In order to get rid of roots, remove about 10–20cm of topsoil from throughout the 30m x 20m marked area. It is important that there should not be any roots or dead grass in the dyke for water to leak through later. Note that the topsoil removed needs to be set aside, to be put back later on the top and outer sides of the pond dyke.

5. Next, mark out a smaller rectangle of 24 x 14m inside the bigger (30 x 20m) rectangle. This will show where the inside of the dykes will be at ground level. This 24 x 14m rectangle is the area of ground that is going to be dug. The earth that is dug out will be used to make the tops of the dykes . The bottom of the dyke in the shallow end of the pond will begin from about another 1.5m inside this smaller

rectangle. The bottom of the bank in the deepest part of the pond will be about 2m from the lower end of this smaller rectangle.

6. Then mark a third rectangle in the centre of the pond, measuring about 21m x 11m. This is called the central area, and represents the flat bottom of the pond.

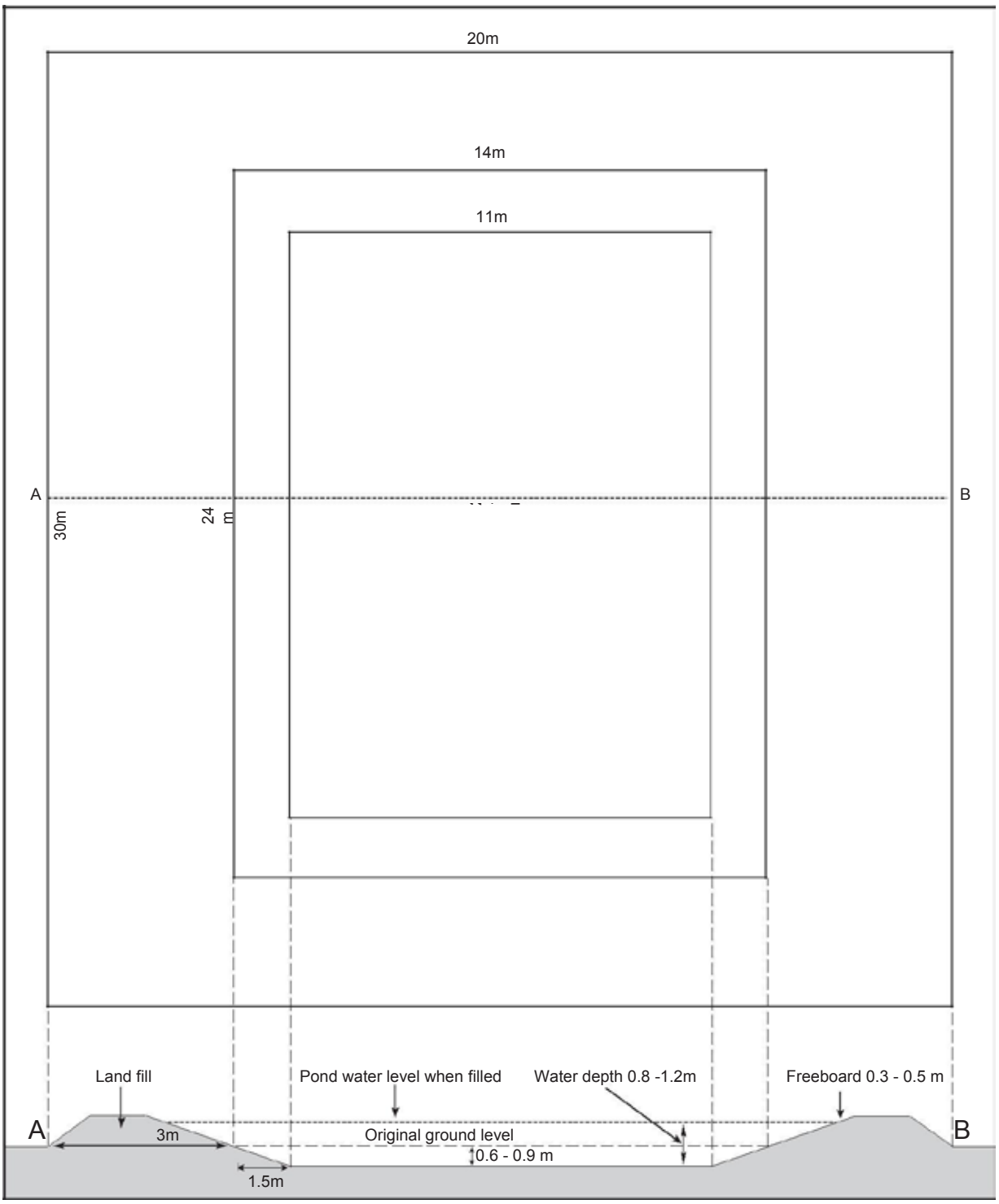



**Fig. 8 Ground plan for a hand-dug pond (top) and cross-section of pond along A-B (bottom)**

### 4.11.29 The digging process

The central 21m x 11m area is dug out first, and the soil is used to build the dyke of the pond. The workers should be organized in a row with shovels and digging forks. The digging begins at the shallow end of the pond, at the string marking the central area.

The pond is dug to about 20cm deep at the shallow end, increasing gradually in depth

towards the other end. At the deepest part, at the string marking the central area the depth should be about 30cm.

As the soil is dug out, it should be placed in the space marked out for the dyke, between the 24m x 14m rectangle and the 30m x 20m rectangle. It is recommended that the soil be placed nearest to the digging area so that the dyke will become higher and wider towards the deeper end. Whenever the loose soil placed on the dyke reaches about 30cm (knee height), it should be packed down tightly. This can be done by compacting the soil with a heavy length of tree trunk.

It is very important to ensure that the slope of the pond bottom be made as regular as possible.

Once the first 20–30cm layer of soil from the central part has been dug out, the whole process can be repeated to take out another layer. As before, begin the process by digging out 20cm deep at the shallow end and 30cm deep at the other end. As before, the soil removed is placed on the dyke area and packed down tightly.

Then, for a third and last time, another layer of soil is dug out of the central area and packed down tightly on the dyke.

### 4.11.30 Shaping the dyke

When the digging is finished in the central area, there will be a hole 21m x 11m with straight sides. The dyke can be then shaped by digging the soil away from the edges of the central area to form a slope up to the 24m x 14m string. This soil can be placed on top of the dyke and packed down tightly with the slope continued smoothly up to the top. The inside of the dyke should slope more gently than the outside (except where two ponds are built side by side). Fig. 7 shows what the dyke should look like when finished. The top of the dyke should be about 1.5m wide, and flat all the way around the pond.

The topsoil removed at the beginning should now be placed on the top and outer sides of the dyke.

The bottom of the pond should be about 1.3m below the top of the dyke at the shallow end, and about 1.7m below the top of the dyke at the deep end. The bottom of the pond should be fairly smooth and regular. All loose soil and other trash from the bottom of the pond should be removed.

### 4.11.31 Ponds side by side

When marking out ponds to be built side by side, leave an extra 1.5–2m between the two big rectangles (30m x 20m markers) to allow for the slopes of the dykes inside the adjoining ponds (Fig. 9b).

### 4.11.32 Installing the water inlet

A water inlet is required to fill the pond with water. This inlet should be placed at the point nearest to the water source. Most often this will be at or near the shallow end of the pond. An inlet pipe should be 25–50mm in diameter, and long enough to reach across the top of the dyke from one side to another. Once the position of the inlet is decided, dig a ditch across the dyke. This should be dug to a level to allow water to flow from the channel or pipe that brings the water from the water source and into the pond a little above the water level on the inside of the dyke.

The inlet pipe can be placed in the ditch in the dyke, and the dyke rebuilt over it.

Alternatively, if an open channel is used to allow water into the pond, erosion of dyke soil can be prevented by using roofing iron or hard plastic to line the bottom of the channel.

### 4.11.33 Installing an upstand pipe

The water level in the pond can be regulated by an upstand pipe. This is mounted on the outlet pipe in an upright position, usually on the end outside the pond, using an elbow fitting. Alternatively, the upstand pipe could be installed inside the pond at the entrance to the outlet pipe, to avoid accidental drainage of the pond, although the outside position is preferable, as it allows the excess water to be drained off from the bottom of the pond. The top of the upright pipe should be at about 3–5cm above the water level of the pond. If water rises above this level, it will overflow into the drain.

The upstand pipe should be tied securely to a pole driven into the ground, so that it does not slip down accidentally and let the water out of the pond (see Fig. 5). When the pond needs to be emptied, the upstand pipe can be untied and gently pushed down, allowing water to flow out of the pond gradually (Fig. 8).

### 4.11.34 Using a siphon

During harvesting and other times, a siphon can also be used to increase the flow of water out of the pond. This could be a 25–50mm flexible hose, long enough to reach over the dyke from pond to drainage ditch. It must be long enough to extend from the deepest part of the pond, over the

### 4.11.35 Screening inlet and outlets

Care must be taken to place screens on the inlet, the outlet pipe and overflow pipe to prevent fish from escaping as well as stop other fish from entering the pond (Fig. 10).

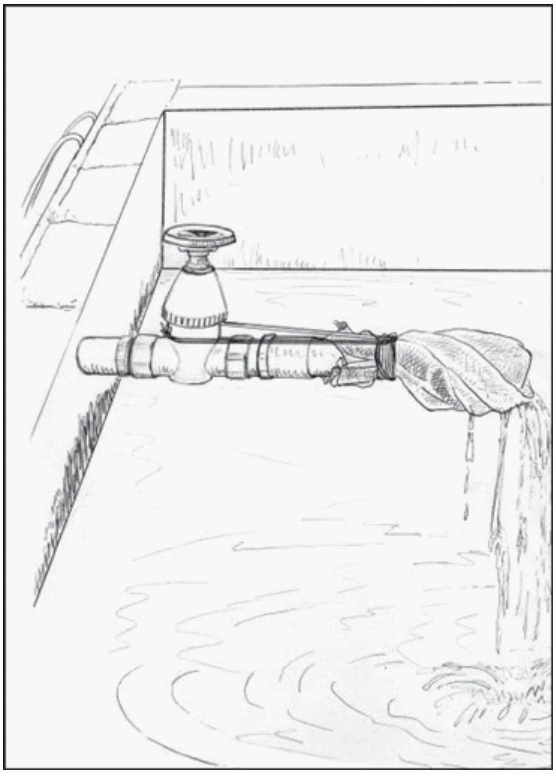


**Fig 9. Mesh screen on inlet pipe**

### 4.11.36 Mechanical construction of ponds

Heavy machinery used for pond construction includes excavators (for example, Hitachi EX-60 model), bulldozers and backhoes. Bulldozers are best, due to their rapid earth moving capabilities and good compacting action. Excavators are a little slow but are very good at making pond dyke slopes and drains. In areas with a high water table, the soil may be too soft to support such heavy equipment. Consult the Fisheries Department for technical assistance.

The usual strategy is to dig out the pond area and use the fill to construct the pond dyke. During the excavation, the machine is run over the pond dykes while they are being constructed in order to continually compact the soil.

The design and layout of the pond is the same as the hand-dug pond, with some adjustments. Normally the top of the dyke would be wider (up to 3m). The operator of the machine should be briefed thoroughly about pond shape, size, bottom-slope and other features, and should follow a similar procedure to that set out for digging a pond manually.

The construction should preferably be carried out during the dry season.

The local aquaculture officer or an appropriately qualified person should be present to supervise the digging operation, to ensure the required procedures are followed.

### 4.11.37 Grow-out of tilapia

The success of a tilapia farm is measured by its profitability. This depends on the yield and market price of fish on the one hand, and the cost of production on the other. The main factors that affect the profit and cost are:

- Size and quality of fingerlings at stocking
- Stocking density of fish in the pond
- Time of stocking
- Length of culture period
- Size of fish at harvest
- Fertilization
- Feed and feeding methods

Most of these factors are interdependent. It is important that these relationships should be carefully thought out.

Feed and oxygen are consumed by the fish. When the supply of feed or oxygen becomes limited at higher stocking density of fish, then less food or oxygen is available per fish and more fish wastes accumulate in pond water. To overcome food shortage, the farmer can increase feeding. To overcome oxygen shortage and accumulation of fish wastes, water can be used to flush out some of the pond water.

The work involved in grow-out of tilapia is like a circle, with a series of steps that, when completed, take you back to the start. This is called the pond cycle (see Fig. 11). To have a good yield of fish the farmer must know about the steps that need to be taken through each pond cycle and the interactions among them:

1. Repair and maintenance (preparation of the pond)
2. Application of lime and fertilizer
3. Filling the pond
4. Additional fertilization
5. Stocking of fingerlings
6. Feeding
7. Daily maintenance
8. Sampling (of fish to determine feeding rate)

9. Harvesting
10. Purging
11. Marketing
12. Record keeping

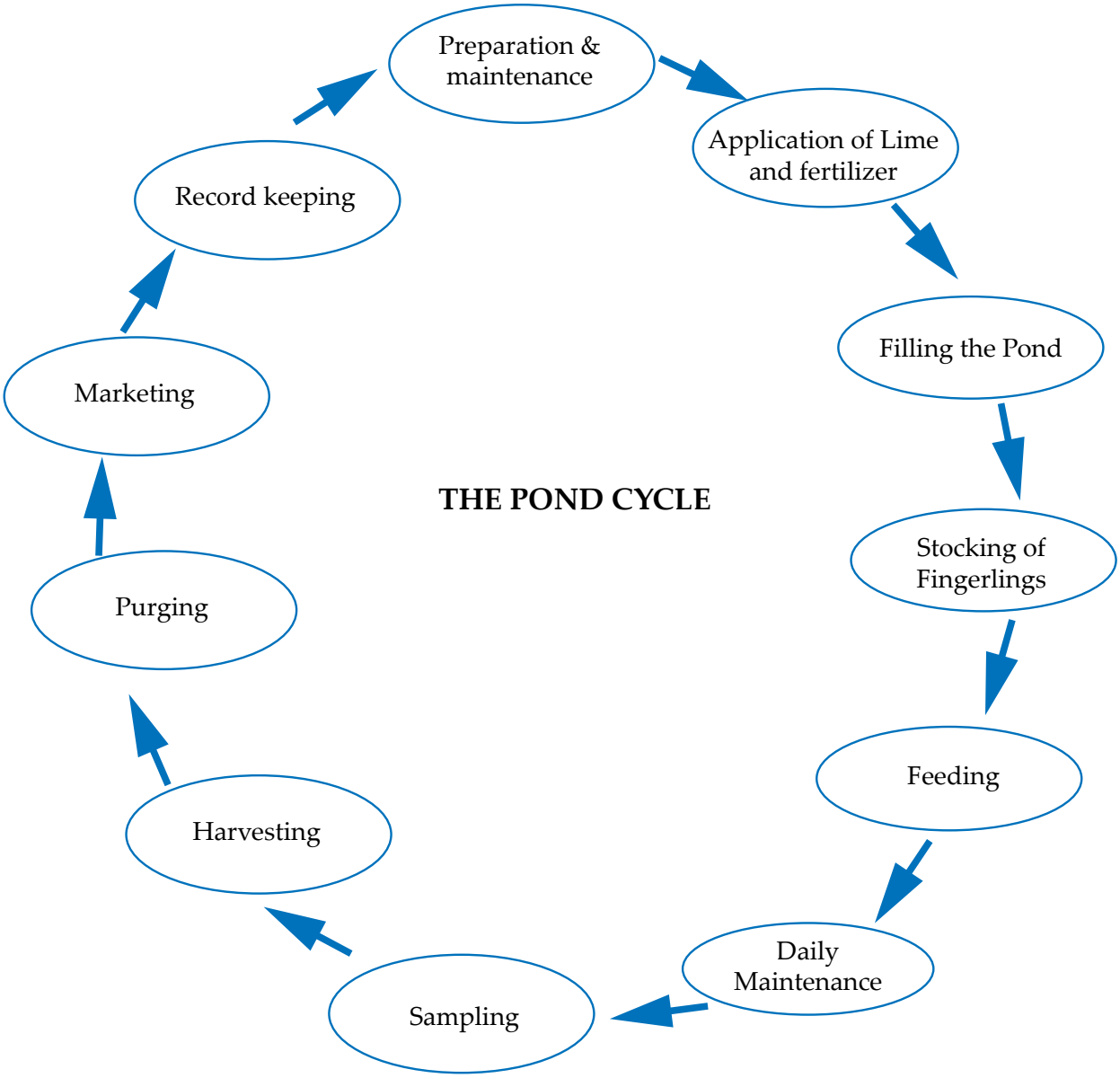



**Fig. 10 The pond cycle**

### 4.11.38 Pond preparation

Pond preparation is necessary prior to stocking, to create a favorable environment for fish growth. Ponds should be drained and dried, if possible until the pond bottom cracks. A dry pond enables the farmer to remove excessive silt and weeds, level the pond bottom, and repair the dykes where they have been damaged.

The grass around the pond should be kept short to allow breezes to blow over the pond water, enhancing pond oxygenation. Grass should not be completely removed, however, as it helps to hold soil on the dykes and reduce erosion. Tall grasses and plants that have grown on the pond bottom should be removed.

The screens on inlet and outlet pipes should be repaired or replaced. Drains should be kept free of wood, trash, or any other blockages.

### 4.11.39 Pest elimination

If ponds cannot be dried out completely, they should be treated (7–10 days prior to stocking) to eliminate any predatory fish or other pests. Common pond treatments are teaseed cake, rotenone (derris roots, which can be available locally), quicklime, or hydrated lime. When applying lime or other preparations, appropriate protective clothing should be worn (Fig. 12).

Teaseed cake. This is a residue of the fruit of a plant (Camellia sasanqua or Camellia semiserrat a) after the fruit oil is extracted. The by-product contains saponin, which is a poison to fish. At a concentration of 10ppm (parts per million), saponin causes fish to die in a few hours. The general dosage is 1kg per 15m$^2$ of pond area, for a water depth of 1m. Teaseed cake in powder form is first soaked in water until dissolved, and this water is then evenly spread into the pond.

Rotenone. This is extracted from the roots of a plant (Derris uliginosa or Derris elliptica). The extracted solution contains about 25% rotenone, which is a poison to fish. The recommended rotenone concentration for pond clearing is about 1.3kg/660m$^2$ of pond area for a water depth of 1m (2ppm). The rotenone solution is first diluted 10–15 times with water and then evenly spread into the pond.

### 4.11.40 Lime application

Lime is added to correct acidity in the pond soil so as to create a favourable environment for the fish. Acidic water will not support the growth of phytoplankton, zooplankton and detritus-digesting bacteria. All these organisms are important to provide a good environment for tilapia growth.

Liming is generally not necessary in inland areas of the Pacific Island countries or in areas with a lot of limestone, because soil in these areas is not usually acidic. Lime may be necessary in coastal locations, especially near mangrove areas where acid-sulfate soils are found. Analysis of soil pH is necessary. The pH (measure of soil acidity) can be measured by using portable colour-test kits or instruments, or by pH meter at a water quality laboratory. The Fisheries Department may assist with the test to determine soil pH, usually at the start of the project. Lime needs to be added to any ponds where the soil pH is less than pH 6.5.

Lime is usually applied once only, at the beginning of each pond cycle. New ponds need to be limed to reduce soil acidity. After that, the need for liming and the quantity of lime used will depend on the soil characteristics. There are several forms of lime. The type of lime most commonly available is agricultural lime or powdered limestone (the kind that is used by gardeners and for white-washing stones etc.), while other types are quicklime and hydrated lime. They differ in strength, so have different application rates. If quicklime or hydrated lime is used, it also kills unwanted pests, so is an alternative to using tea seed cake or rotenone.

| Rates of application: | | |
|---|---|---|
| Limestone (powdered) $CaCO_3$ | 1000–2000kg/ha | 1–2kg/10m$^2$ |
| Quicklime CaO | 400kg/ha | 400g/10m$^2$ |
| Hydrated lime Ca(OH) | 600kg/ha | 600g/10m$^2$ |
| | | |

Quicklime. When quicklime (CaO) absorbs water, it transforms into calcium hydroxide Ca(OH)2. This raises pH and draws oxygen from the water. The effect of quicklime is to kill unwanted fish, pests and bacteria as well as to reduce soil acidity (raise pH).

Limestone. Agricultural lime (powdered limestone) can also be used to raise the pH of pond water. The rate of application for limestone is generally twice that of quicklime. It should be added to the pond before filling with water.

A typical application rate for lime can be from 1kg for every $10m^2$ (for established ponds) to 1kg per $5m^2$ (for new or very acidic ponds).

Lime is usually sold in 20kg bags, and can be applied by hand after cutting the bags open (see Fig. 12). Avoid breathing in the lime dust, by wearing a spray-painting mask or similar protective gear, and wear gloves. Quicklime is more dangerous than agricultural lime. Read the safety instructions and wear eye protection.

Spread the lime out over the damp earth in a thin layer that covers the entire pond bottom. Close the pond water outlet so that rain or seeping water does not wash the lime out of the pond. Allow the lime to settle for 2–4 days before fertilizing and filling the pond with water. This will allow time for the lime to soak into the soil and condition it properly.

When the pond is filled, if the pH of the water is too high (above pH 9), it can be improved by "ageing". This means leaving the water 2–4 weeks before stocking, to allow natural biological processes to adjust the pH.

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**Fig. 11. Application of lime**

### 4.11.41 Fertilizing and filling the pond

Once no pests remain in the pond, and lime to counteract any acidity in pond soil has been applied, fertilizers can be broadcast over the pond bottom. Chicken manure can be broadcast over the pond bottom at the rate of 1000–2000kg/ha. Inorganic fertilizer, at the rate of 100– 200kg/ha, can also be applied in combination with the chicken manure. The fertilizer encourages the growth of plankton that will provide natural food for the tilapia.

The pond can be filled to about 30–50cm depth initially, so that it can be easily warmed by the sun during the day, allowing good growth of plankton.

Fertilizer can also be added, in a sack floated in the pond (Fig. 12). The fertilizer rates may be increased or reduced depending on how well the plankton grows.

The plankton should be maintained (by addition of more fertilizer) throughout the grow-out period. Types and amounts of fertilizer are discussed in more detail in the Fertilizer section.

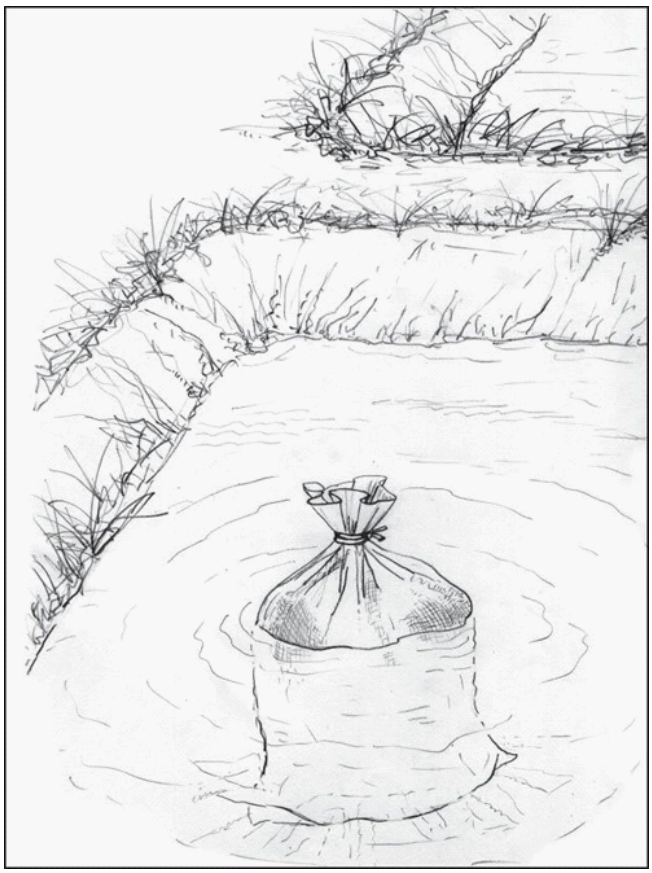


**Fig. 12. Sack of manure in the pond**

### 4.11.42 Stocking of fingerlings

When sufficient natural food (plankton) is present in the pond (see Daily Management section), the pond is ready for stocking. Usually fingerlings about 4–5 weeks old and 2–3g average body weight are used to stock the grow-out pond, where they will remain until harvesting. The pond water depth, initially about 30–50cm, can be increased to 80cm after about 30 days to provide more water for these fish as they grow bigger.

Good-quality fingerlings of similar age and size must be stocked. Do not use small fish from creeks or drains, or the ones leftover in ponds after harvest, as their ages and quality are unknown and these fish may start to breed early.

### 4.11.43 Transporting the fingerlings

If the hatchery supplying the fingerlings is a long distance away by road or on another island, the supplier will need to carefully prepare and package the fingerlings for transportation. The methods used for fingerling packing and transportation are described in Volume One, Tilapia

**Hatchery Operation.**

On receiving the shipment of fingerlings, the farmer should not delay in releasing them into the pond. Most importantly, the fingerlings should not be left in the hot sun to get too warm.

On arrival at the pond site, the fish should not be immediately released into the pond, because sudden changes in water temperature or water quality can harm the fish. In the pond, the fish need to adjust gradually to the temperature of their new environment, especially when there is a difference of 5°C or more in temperature between the transport container and the pond water. Bag water temperature can be adjusted slowly to pond water temperature by floating the transportation bags in the pond for 15–20 minutes before opening them.

Sudden changes in water quality (for example, water pH) can also be harmful, so the fish need time to adjust to their new water conditions. Once bags are open, splash in some pond water by hand to mix 50:50 with the water in the bag or container. After another 15 minutes, tip the bag on its side and allow the fish to swim out by themselves

### 4.11.44 Stocking density

In order to maximize the profit from the fish farm, the stocking density needs to be as high as possible. Fish stocked at low density will grow faster than fish stocked at a high density in fertilized ponds, but densely-stocked fish can also grow fast if they are given supplementary food and managed properly. If there are too many fish in the pond, however, they will feel crowded and stressed and will grow much more slowly.

There are three kinds of culture systems based on stocking density, level of inputs and management.

- Extensive culture, where fish depend on the natural food present in the pond, stimulated by fertilization. No supplemental feed is given to the fish and stocking density is 1 fingerling/$m^2$ (10,000 fish/ha).

- Semi-intensive culture, where the fish are given supplementary feeds in addition to having the natural food present in the pond, stimulated by fertilization. In this system the stocking density is 3–8 fingerlings/$m^2$ (30,000–80,000 fish/ha). In some farms it can be higher than 8 fish/$m^2$.

- Intensive culture, with stocking density of more than 8 fish/$m^2$ and intensive feeding plus water movement and aeration in order to maintain a high oxygen level in the pond. Water quality is monitored regularly. This system can use tanks or raceways as alternatives to ponds.

Another factor in choosing the stocking density is the market size desired at harvest. The farmer should determine what size fish are wanted and stock the ponds accordingly. Factors to take into account when deciding how many fish to stock include the following.

- It may be your first time growing fish and you do not have enough money to buy feed, so you decide to use natural food and a low stocking density. After the first harvest some of the money made can be used to buy supplementary food that will allow more fish to be stocked.

- It may be the dry season and the pond is shallow. It is not necessary to wait for the wet season to start growing fish.
- If buyers only want large size fish, then stocking fewer fish in the pond will allow them to achieve more rapid growth and large size fish.

### 4.11.45 Daily management

Because tilapia tolerate low levels of dissolved oxygen, in semi-intensive culture they generally do not require large quantities of water to be flowed through the pond. However, water must be available to replace water lost through seepage and evaporation and also, when necessary to flush out any heavy phytoplankton "bloom".

The management of pond water quality is important. Water temperature, dissolved oxygen, pH, salinity, and amount of plankton must all be managed to provide the best possible environment for growth and general well-being of the fish. For semi-intensive operations, at least occasional checks should be made of water temperature, salinity, dissolved oxygen and acidity (pH), to ensure that values remain in the range known to be good for tilapia growth (see Table 1).

**Table 2. Threshold water quality values for tilapia farming**

| Water factors | Level |
|---|---|
| Temperature | 25–30°C |
| Dissolved oxygen (DO) | 3mg/L |
| pH | 6.5–9.0 |
| Salinity | <5–10ppt |
| Water colour (amount of plankton) | 30–35cm Secchi reading |

### 4.11.46 Temperature

Fish are cold-blooded animals and their body temperature depends on the temperature of the water. Tilapia do not thrive at low water temperature but are very tolerant to high temperatures. Activity and feeding of tilapias are reduced below 20°C and feeding stops completely around 16°C. It is difficult to have control over water temperature of the ponds in cooler months, except by reducing the water depth and cutting back shade around the pond, to allow the water to be warmed by sunshine during the day.

### 4.11.47 Salinity

Adult Nile tilapia can tolerate salinity of up to 30ppt (parts per thousand) if the salinity increases gradually so they have time to get used to it. Fingerlings and small juveniles are happiest at less than 10ppt and will all die if water goes above 14ppt. There is no need to worry about salinity if the ponds are far from the sea.

### 4.11.48 Acidity

The pH of the water is a measure of acidity (the hydrogen ion content in the water). The water is "acidic" when the pH is 1–7 and "basic" or "alkaline" when pH is 7–14. At pH 7 the water is "neutral". Tilapia can survive in a wide range of water pH. However, the recommended pH for good growth of tilapia is 6.5–9. Acidic water (with a low pH) will not support the growth of the phytoplankton, zooplankton and detritus-digesting bacteria that are important for fish growth.

If the pond is limed properly during its preparation, there is no need to add any more lime while fish are in the pond. The pH of the pond water will vary on a daily basis, because during the day, when the sun is shining, phytoplankton, remove $CO_2$ from the water and

use it for photosynthesis. This removal of $CO_2$ can make the pH of the pond rise to about 9 on a sunny day. During the night, however, phytoplankton will release $CO_2$, causing the water to become more acidic and the pH to drop again. These day–night fluctuations in pH are normal. There is no need to worry about them so long as pH values are mostly in the "good fish growth" range of 6.5–9.0. Tilapia can tolerate pH of 5.0–10.5 without dying, although such extreme values are not good for growth.

### 4.11.49 Dissolved oxygen (DO)

Like all living things, fish need oxygen to live. Tilapia can survive in extremely low oxygen levels but will not grow well under such conditions. Phytoplankton produce oxygen in the day but use it at night, so pond oxygen levels will be higher in the daytime and lower at night. For good fish growth, the oxygen level should ideally be above 3mg/L in the daytime, though as low as 1mg/L measured in the early morning has been found acceptable.

Oxygen dissolves into pond water (1) from the air, slowly, (2) from phytoplankton in the water, during the daytime, (3) by the action of waves created by wind, (4) by addition of new water, and (5) by rain water splashing onto the water's surface.
The following should be noted:

- Fingerlings use more oxygen than adult fish
- Healthy, fat fish use more oxygen than unhealthy, thin fish
- Fish use more oxygen when they are active, so more oxygen is needed during the day than at night
- The more excited fish become, the more energy they consume and the more oxygen they use.

### 4.11.50 Plankton

These are microscopic organisms that live in the pond water. They include plants (phytoplankton), animals (zooplankton) and bacteria. Plankton provides both natural food and oxygen for the fish. When there is enough phytoplankton in the water to give it a green or brown colour, the water is said to have a plankton "bloom". The best type of "bloom" is green in colour, as the water then has phytoplankton in sufficient density to provide adequate oxygen in the daytime, and sufficient natural food for the fish. The bloom may be controlled through fertilization to increase plankton growth or by adding fresh water to reduce plankton by washing it out of the pond.

Phytoplankton, being microscopic plants, add oxygen to the water during the daytime but stop producing oxygen during the night and start using it. The plankton "bloom" provides the fish with oxygen during the day. However, it can use so much oxygen during the night that fish may end up dead if the plankton bloom is too heavy. The early morning (before dawn) is when DO will be lowest, so this is the most dangerous time for the fish.

### 4.11.51 Daily activities

The condition of the ponds and the behaviour of fish should be observed twice daily, morning and afternoon. Water colour, water smell, and fish activities including surfacing behaviour should be noted. If the fish gasp for air at the water surface in early morning (behaviour called "piping") and continue to surface after sunrise, the DO content is too low and fresh water should be added into the pond. Fish that are surfacing to eat food will swim forwards, and this is a good sign. Fish surfacing to gulp air tend to move slowly backwards as they gulp, and this is a bad sign.

Water turbidity or transparency can be measured by a Secchi disc (Fig. 15). A Secchi disc base can be made from a white ice cream container lid, 20 cm in diameter, painted with alternate black and white quadrants, and nailed onto the end of a metre-long stick marked with a centimetre scale.

The disc is held underwater and at the depth where it just disappears from view, the depth is read off the marked scale. Ideally, the plankton density should be such that a Secchi disc immersed in the water just disappears from view at a depth of 30cm. If the Secchi disc disappears at a depth of 20cm or less, the water is too turbid, and new water should be immediately flowed into the pond to wash some of it out. Alternatively, the plankton density in the water is ideal when the up-turned palm of the hand just disappears from view when the arm is immersed up to the elbow.

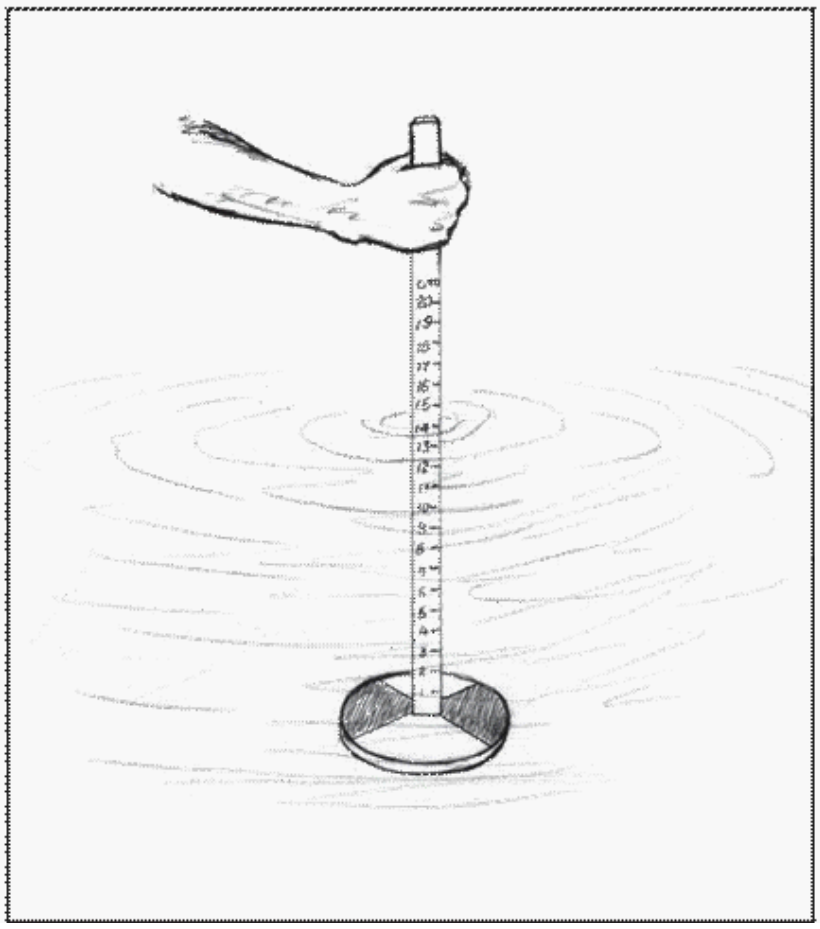


**Fig. 13. A Secchi disc in use**

If the "bloom" is too heavy (Secchi value of less than 20cm), for example during hot dry weather with a lot of sunshine, the phytoplankton will use large amounts of oxygen at night. This can cause die-off of both fish and plankton. In such cases the colour of the water will change from green to brown and even to black.

Fish will die in the night from lack of oxygen will be seen floating at the water surface. If this happens, flush out the pond with new water. If there is a shortage of water and flushing cannot be done, then reduce or stop feeding the fish, stop adding fertilizer, and remove any fertilizer bags in the pond.

Management of a pond involves a daily routine of tasks, which may include checks on:

- pond water level (at least 80cm deep)
- activities of fish (actively feeding, or gasping at surface)
- water inlet and outlet, to ensure mesh screens are in place and not clogged
- colour of pond water (Secchi disc reading 30cm or more)
- growth of aquatic weeds, dyke erosion, damaged water lines
- any dead fish floating

The daily observations should be written down in a notebook or pond logbook. These records will provide information on the performance of the ponds at different times of the year or under different management methods.

### 4.11.52 Fertilizer

The purpose of adding fertilizer to tilapia grow-out ponds is to encourage growth of natural food organisms (plankton) in the pond. More natural food means faster fish growth, and less supplementary feed will need to be added.

Fertilization provides phytoplankton with more nutrients, which leads to more phytoplankton growth. Zooplankton (animals, like tiny shrimps and water insects) will feed on phytoplankton, so will also flourish if fertilizer is added. Tilapia feed on both phytoplankton and zooplankton, as well as any supplementary feed added to the pond. The importance of pond fertilization is that it is a cheap way to provide food for the fish, for the following reasons:

- Fertilizer provides nutrients for phytoplankton growth. The two main nutrients are nitrogen and phosphorus
- Tilapia will eat plankton all day long
- Plankton contains a lot of protein. Protein is useful in body building, and puts more meat on the fish

There are two main types of fertilizers that can be used. Natural organic fertilizers include manure of animals such as chickens, cows, goats, pigs, or horses. Manmade or inorganic fertilizers commonly used are urea, TSP and superphosphate. Inorganic fertilizers may be single element fertilizers that contain a single nutrient like nitrogen (in ammonium sulfate, urea) or phosphorus, incomplete fertilizers that contain two nutrients such as nitrogen and phosphorus, or complete fertilizers that contain the three important plant nutrients, nitrogen (N), phosphorus (P), and potassium (K).

The advantage of organic fertilizer is that it is cheaper, or may even be obtained free-of-charge. It may also be more easily available in many rural areas. The disadvantages are that it requires more work to collect, is smelly to work with, and people may not want to buy the fish because they think the fish are being fed on manure.

The advantages of inorganic fertilizers are that they are easy to use, do not smell, and are always the same strength. The disadvantage is that they are more expensive to buy.

If there is a range of choices, then experience over time will give an idea of which fertilizer gives the best value for money.

**Table 3. Recommended fertilizer application rates**

| Type of fertilizer | Amount to use per $m^2$ |
|---|---|
| Urea | 6g |
| TSP | 3.5g |
| Superphosphate | 7g |
| Chicken manure | 15g |
| Cow manure | 70g |
| Pig manure | 50g |

**Table 4. Fish tin measurements**

| Fertilizer | Small fish tin | Large fish tin |
|---|---|---|
| Urea<br>TSP<br>Superphosphate | 180g<br>250g<br>250g | 315g<br>480g<br>480g |

There are two ways to apply organic fertilizers. For fast action to quickly stimulate a plankton bloom (for example, when the pond is initially filled with water), first dissolve the manure in a drum of water then pour it into the pond. Inorganic fertilizers can also be dissolved in a bucket of water for fast action. TSP needs warm or hot water to dissolve properly.

For a slower action (to slowly release nutrients over time to maintain a steady plankton bloom), put manure into flour sacks and tie the top (see Fig. 13), and leave the sacks floating in the pond. Take the sacks out again if the Secchi disc reading tells you that the bloom is getting too heavy.

If the pond water is not very green (Secchi value is greater than 30cm) then add a little bit more fertilizer. If the pond water is very green (Secchi value is less than about 20cm) then take out any sacks from the pond, or open the water inlet for a short time to flush the pond.

Fertilizer should be stored in a dry, airy place that is well protected from rain. To keep inorganic fertilizer from getting damp, which will make it go hard, do not allow the fertilizer bags to touch cement or dirt floors. Store them on wooden pallets.

### 4.11.53 Feed and feeding

Although tilapia feed on plankton in pond water (natural food) and so can be grown without supplementary feeding, supplementary feeding will result in better growth and thus more profit. With natural food alone, the production of tilapia can be around 500kg/ha/cycle. With supplementary feeding (Fig. 16), production can increase to 6000kg/ha/cycle.

Since the growth of fish is strongly dependent on their foods and pattern of feeding, to make a good profit from tilapia farming it is necessary to understand the food requirements of tilapia. Tilapias are omnivores, generally feeding on phytoplankton, zooplankton, organisms living on the pond bottom (benthic organisms), detritus (waste produced by organisms in the pond), small fish, and aquatic plants. In captivity, tilapia readily accept artificial diets such as a powder mash or crumbled or pellet feed, if sized appropriately to fit into their mouth. This means that a wide range of supplementary feed can be used. Supplementary feed can be either agricultural by-products (of plant origin, or animal origin), or specially formulated diets.

**Fig. 14. Supplementary feeding of fish**

### 4.11.54 Feeds of plant origin

- Forages. These are leaves of grasses, aquatic plants, and vegetation in general. A good example is chopped cassava leaf (use the sweet kind with red stems, and only give to fish older than 1 month; chop the cassava leaf very finely).

- Root crops. These are tubers of sweet potato, cassava etc.

- Grains. These include rice bran, rice pollard, corn and corn meal, soya bean meal, broken rice, wheat-flour mill mix. They are **fed** whole, or ground into meal and mixed with other feed ingredients, or made into pellets.

- Fruits. Fruits, nuts, seeds, including copra meal or the grated and squeezed coconut left over after making coconut cream.

### 4.11.55 Feeds of animal origin

- Manures. Fish will eat good quality, dried chicken manure directly if they are hungry.

- Meat, fish and their by-products. For example, fish meal, meat-and-bone meal.

- Formulated diets. These are a mixture of ingredients formulated to give fish a nutritionally balanced diet. The feeds can be supplemental ("partial" diet), or complete (containing all essential nutrients in amounts necessary for normal growth). Supplemental feeds in combination with natural food in the pond (plankton) can provide a nutritionally complete diet for tilapia.

When the stocking density is low (less than 2 fish/$m^2$), the natural food in a fertilized pond is sufficient to support adequate growth of fish. With a higher stocking density the natural food will be insufficient and growth of fish will be slowed as the fish grow larger. A point is reached where available natural food is sufficient only for maintenance of a fish population that has stopped growing. This point is termed the "carrying capacity" of the pond. To increase the carrying capacity (and so increase fish production from the pond) the fish need to be given supplementary feed.

Natural plankton food contains 50–60% protein on a dry matter basis. This is above the protein requirement for tilapia (which is 23–35% for adults). When tilapia live exclusively on natural food, the excess protein is used for energy. When the carrying capacity is reached, it is energy that is in short supply, not protein. For this reason, supplementary diets should be relatively high-energy feedstuffs (for example, high in carbohydrate). Such feedstuffs are usually cheaper than those high in protein (protein from animal sources is especially expensive).

Most formulated diets come in powder, meal, crumble or pellet form. Powder or meal

forms are used normally for fry, crumble for fingerlings and juveniles, and pellets for the adult fish. Good tilapia feeds contain 25–35% protein, 2–10% fat, and 4–12% fibre. For fry and fish under intensive culture, a feed with higher protein levels and added vitamins and minerals is needed.

### 4.11.56 Guidelines for feeding

- Feed every day or at least 6 days per week, unless conditions of low dissolved oxygen arise.
- Weigh out the fish food into the amount to be given at each feeding time.
- If there is no weighing scale, take a scoop (empty fish tin or some other container) and some feed to the Fisheries Department or a shop, and weigh one scoopful of feed. From the weight of one scoop, work out how many scoops to give to the fish at each feeding time.
- Feed according to the total weight of fish in the pond, and increase the amount of feed as fish weight increases. Sample the fish every 2–3 weeks to calculate the weight increase (See the section below entitled Daily Feed Ration for an explanation about how to calculate the amount of daily feed from the fish sample weights).
- Feed 2–4 times each day, in the same place and at the same time if the pond is small. If the pond is large, feed along the length of the dyke.
- Feed slowly; do not "dump" feed all at once.
- Feed with the wind behind, so that any dust (called "fines") blows into the pond and can also be eaten.
- Reduce feeding on overcast days, or if fish are "piping".
- Do not overfeed. Watch the fish to ensure they are feeding properly. Check the pond bottom for any uneaten, rotting feed.
- Tilapia are not very active during the night, so it is no use feeding them after dark.

### 4.11.57 Sampling

Sampling of the fish should be done once every 3 weeks (or at least once per month) to find out how much fish have grown, so that the amount of supplementary food can be increased to keep pace with their growth. To calculate the Daily Feed Ration (DFR), which is the amount of feed to be given to the fish in the pond each day, the total number of fish stocked into the pond at the beginning needs to be known and the Average Body Weight of the fish (ABW) needs to be estimated.

A variety of methods can be used to catch a sample of fish for weighing: for example, cast net, seine net etc. It is important to use a method that does not disturb the pond bottom excessively.

It is better to sample in the cool of the morning or evening. The fish should be weighed as soon as they are caught, then released again.

Measuring the weight of 30–50 fish from the pond should be adequate. The fish can be weighed individually or all together. Two buckets are required, one with holes and one to hold water (Fig. 17). The bucket with holes is weighed, then placed in the second bucket, and filled with water. The fish are netted and transferred to this bucket. After the fish have been added, the bucket with holes is lifted gently, allowing the water to drain into the second bucket. Allow time for the water in the bucket to drain as much as possible while gently shaking the bucket. Weigh the bucket using a spring balance that can weigh

accurately, or a top-loading balance.

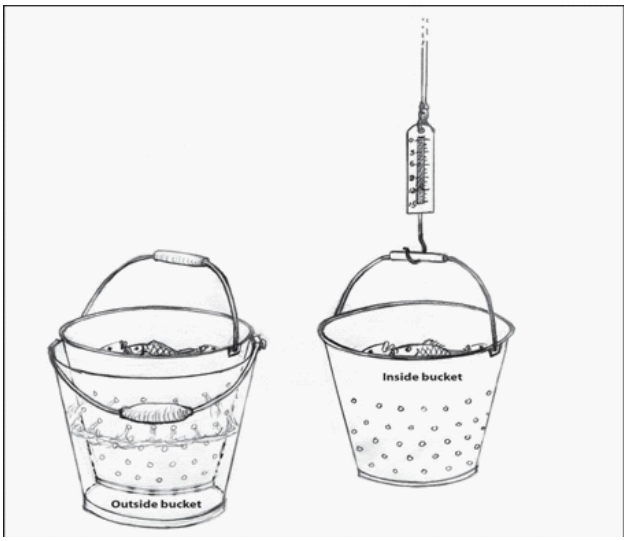



**Figure 15: Weighing of Fish Sample**

The weight of fish in the bucket is the difference between the weight of the empty bucket and the weight when the bucket contains the fish. The Average Body Weight (ABW) is calculated by dividing the weight of the sample of fish by the number of fish in the sample:

ABW = Total weight of a random sample of 30–50 fish

Number of fish in sample

### 4.11.58 Daily feed ration

The amount of food to give is calculated from the amount of food required by one fish each day, expressed as a percentage of the fish body weight (the feeding rate per day). The feeding rate is different depending upon the size and age of the fish. Table 4 provides a guide for feeding tilapia at 24–30°C using quality formulated feed.

**Table 5. A guide for supplementary feeding of tilapia**

| Body weight of fish (g) | Number of fish per kilogram | Feeding rate | No. of feeds per day |
|---|---|---|---|
| 1–5 | 1000–200 | 10–6% | 4–6 |
| 5–25 | 200–40 | 5% | 4 |
| 25–150 | 40–7 | 4–3% | 4 |
| 150–250 | 7–4 | 3% | 3-4 |
| 250–450 | 4–2 | 2–3% | 2–3 |

The Daily Feed Ration (DFR) is calculated by multiplying the estimated total weight of fish in the pond (number of fish stocked into the pond at the beginning multiplied by the Average Body Weight of the fish sampled) by the feeding rate appropriate for the fish at their current size.

DFR = Feeding rate per day x ABW x Total number of fish

This total daily feed amount is divided up into several feeds a day. Small fish need to be fed more often each day than large fish. For example, for a daily feed amount of 4kg for small fish being fed four times a day, 4kg is divided by 4. In other words, give out 1kg of fish food at each feeding time, four times a day.

### 4.11.59 Total feed requirement

The Total Feed Requirement (TFR) is the total amount of food needed for a whole pond cycle from stocking to harvest. TFR is found by first calculating the amount of feed given between each of the sampling dates (by multiplying the daily food ration DFR by the number of days that a particular DFR was given from the previous sampling to next sampling), then adding all these amounts together.

Total Feed Requirement between sampling dates 1 and 2:

TFR1 = DFR1 x Number of days from date 1 to date 2

Calculate a separate TFR for the time period that each DFR value was used, then add all these TFR values together.

Recording this in the logbook will guide you in future on how much feed to buy, and on how much money should be set aside to buy fish food during a pond cycle.

**Worked example of Total Feed Requirement**

A pond was stocked with 250 fish at 3g size. At the initial feeding rate of 10%:

$DFR_1$ = 0.10 x 250 x 3g

= 75g of food per day

After 21 days, the fish were sampled and ABW was 20g. At the new feeding rate of 5%:

$DFR_2$ = 0.05 x 250 x 20g

= 250g of food per day

After another 21 days, fish were again sampled and ABW was 35g. Feeding rate was now 4%:

$DFR_3$ = 0.04 x 250 x 35g

= 350g of food per day

The fish were fed for another 21 days before sale. What is the Total Feed Requirement over this period?

TFR = ($DFR_1$ x 21 days) + ($DFR_2$ x 21 days) + ($DFR_3$ x 21 days) = (75g x 21 days) + (250g x 21 days) + (350g x 21 days) = 1575g + 5250g + 7350g

= 14,175g

A total of 14,175g (14.2kg) of fish food was fed over this 63-day grow-out period.

### 4.11.60 Food Conversion Ratio

The Food Conversion Ratio (FCR) is the amount of food used to produce one kilogram of fish.

Calculating the FCR shows whether the fish are overfed or underfed. For example, if fish are fed according to the suggested guidelines, but they seem to be growing rather slowly and the FCR value is low, this indicates they can be given more food to speed up their growth. On the other hand, a high FCR value can indicate overfeeding.

FCR over one pond cycle is calculated from the Total Feed Requirement (TFR) and the Total Weight Gain (TWG) of fish. The TWG is the difference between the total weight of fish harvested and the initial weight of fish stocked. It can be calculated from an estimate

of the ABW at time of harvest multiplied by the number of fish harvested, or taken directly from pond fish-sales records.

TWG = (Final ABW x Number of fish) – (Initial ABW x Number of fish)

FCR = TFR

TWG

An FCR value of 1.5 means that 1.5kg of supplementary feed was used to produce 1kg of fish.

For semi-intensive culture, FCR values of 1.2–1.5 are considered good. In intensive systems, higher FCR values of 2–2.5 are likely because hardly any natural food will be available in the pond.

If the FCR value is very high, for example FCR of 7, then it is likely that not all the food is being eaten, and so food is being wasted. Another explanation is that the food is of very low quality, so that much more of it has to be eaten by the fish in order to grow.

### 4.11.61 Harvesting

Tilapia can be harvested starting from about 3–4 months after the fingerlings have been stocked, provided water temperature remains suitable and good quality supplementary feed is provided. The exact time for harvesting is determined by factors like the preferred market size for fish, and by opportunities to achieve good volume of sales and good prices (for example, Fridays, civil service paydays, Christmas time etc.).

There are two types of harvest: partial harvest, and complete harvest. A partial harvest can be done using a seine net or a cast net, but for a complete harvest the pond is seined 3–4 times and then drained to get all the remaining fish.

Do not feed the fish on the day before harvesting, so as to allow the fish to empty their guts. This will improve the survival and condition of the fish during handling. If necessary, run clean water through the pond for a day to reduce any off-flavour in the fish. It is preferable to harvest early in the morning so that the pond water is still cool while the pond is emptied. This will reduce fish stress while they are being seined or collected. All equipment needs to be prepared in advance: for example aeration, inflow of clean water, holding tanks or hapas, buckets, seine nets, scoop nets etc. A seine of 1–2cm mesh size with a height of 2–3m is commonly used. For every 2m of pond width, 3m length of seine net is needed.

To effectively harvest tilapia in ponds, several people are needed, to hold the lead line of the net firmly on the bottom of the pond, the float line above the water surface and to pull the ends of the lines. Tilapia are adept at escaping a seine net by jumping over or burrowing or slipping under it. Stretch the seine from dyke to dyke and haul it gradually. Even with several people, harvest of more than 40% of the tilapia per seine haul is difficult. In order to harvest all the fish in the pond, seining is carried out 3–4 times and then the pond is emptied.

### 4.11.62 Partial harvesting

A partial harvest is catching only some of the fish in the pond. For example, the farmer may wish to take only the big size fish to sell in the market or to feed his family or for a special occasion. Partial harvest can be done either by seining or by using a cast net.

The harvesting can start at about 3 months after stocking the fingerlings, or when the fish are big enough to eat (200–300g size). Partial harvests can be continued until the fish have been in the pond for 5–7 months, or until there are only few left.

When most of the fish have been harvested, drain the pond and collect the remaining fish. Do not leave any fish in the pond. Kill any unwanted fish (e.g. by liming the pond) before refilling for another pond cycle. Keep records of all the fish taken out (see Record Keeping section). Count the number of fish taken out each time or at the very least record the weight of fish taken each time you harvest.

### 4.11.63 Complete harvest

A complete harvest is usually carried out 4 months after stocking. Complete harvest requires draining of the pond. To speed up the harvesting, seining is carried out while the pond is draining. When the pond is drained completely, fish are confined in the catch pit or in puddles of water and these remaining fish are scooped or collected by hand. A net bag can be held on the outside of the outlet pipe to catch any fish that escape down the pipe, or the inside of the pond can be screened around the outlet pipe to stop fish from escaping.

### 4.11.64 Fish handling

"Fish handling" is taking the fish out of water and carrying them about, for example when transferring them from one tank or pond to another, or for sales of live fish. It is important to be gentle with the fish and keep the amount of handling to a minimum, to avoid injury and stress that can lead to damage or death.

If it is planned to sell fish alive, then handle them gently, avoid overcrowding them in containers, and do not pile them up in heaps in the net or container. Overcrowding will damage the fish (bruise the skin) and a lot of fish will die the following day.

The following guidelines will help keep the fish in good condition.

- Handle the fish in the cool of morning or under shade, and use aeration and lots of flowing water.
- If fish are crowded in containers for a time, ensure water is clean, and has air bubbling or running water flowing through it.
- Fish in small containers should not be too overcrowded. A sign of overcrowding is when fish come to the surface to gulp air (piping). Either provide vigorous air bubbles through the water, or provide clean running water from a tap or hose, or reduce the number of fish per container.
- Scoop nets used for handling fish should be of soft material to avoid bruising of the fish. Seine nets should be fine-mesh, as coarse-mesh nets will trap the fish by their gills and cause injury.
- Handle fish gently: avoid dropping fish on the ground, or leaving them out of water.
- When holding or carrying adult fish, cover the eyes with one hand so that the fish will remain calmer (Fig. 16).

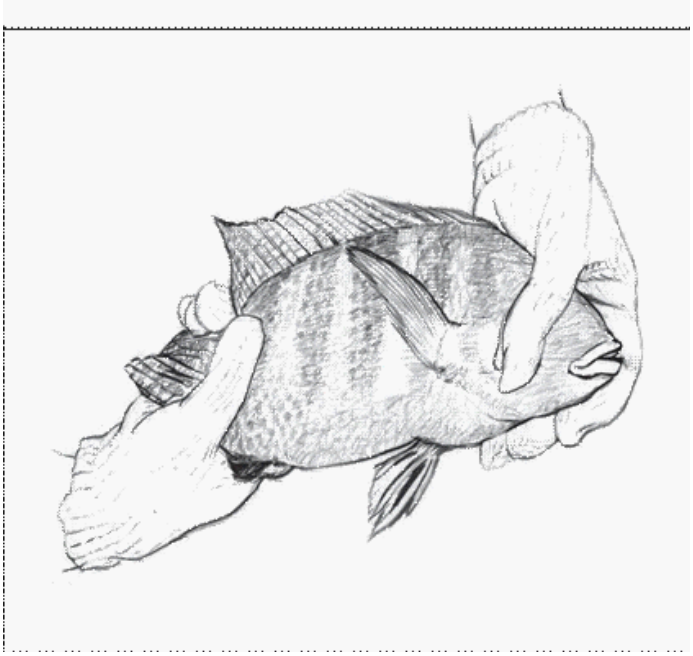


**Figure 16: When handling fish, wear gloves to obtain better grip and cover the eyes so fish remain calm.**

### 4.11.65 Purging

It is most important that fish be allowed time to purge themselves in clean water before they are sold, since fish with an objectionable flavour such as a muddy, earthy smell and taste are not preferred by consumers. Selling fish with an off-flavour could lead to a drop in the market acceptance of fish for a long period.

The cause of the off-flavour has been found to be actinomycetes or blue-green algae in the pond water. These organisms grow on mud that is high in organic matter.

Off-flavour in tilapia can be controlled in two ways:

- Control of the algae in the pond
- Removal of the off-flavour from the fish by purging before marketing

One practical method is to stop feeding the fish a day before harvest and allow clean water to run through the pond.

Next, the harvested fish can be held in a tank with clean running water and aeration for at least 12 hours before being sold. This gives the fish time to purge their gills and guts of any off-flavour and will "clean" them.

Selling fish with good flavour will boost the reputation of tilapia as a product that people will want to buy and help maintain good prices for tilapia. The farm should have a small cement tank or plastic-lined tank (e.g. 3m x 3m x 1m) with clean running water for purging fish, and for holding live fish for sales from the farm itself.

### 4.11.66 Fish marketing

In areas where tilapia farms are established for the first time there will be a need for promotion and market development, since tilapia will be a new fish to the consumers. To market tilapia through local retail outlets may be difficult unless some attempt is made to educate the consumers about tilapia. Potential farmers will find it necessary to obtain contracts from market outlets that specify the amount and price of fish to be sold, before credit agencies will be willing to provide financing.

Tilapia can be sold in several ways:

- As live fish in tanks: tanks and accessories are needed for sale in the marketplace (Fig. 20)
- Whole and fresh, sold soon after harvesting and sold by weight

- Whole and fresh, sold soon after harvesting and sold by the bundle
- Whole and frozen (gutted before freezing)
- Whole and on ice
- Smoked
- Fried or cooked in the local custom

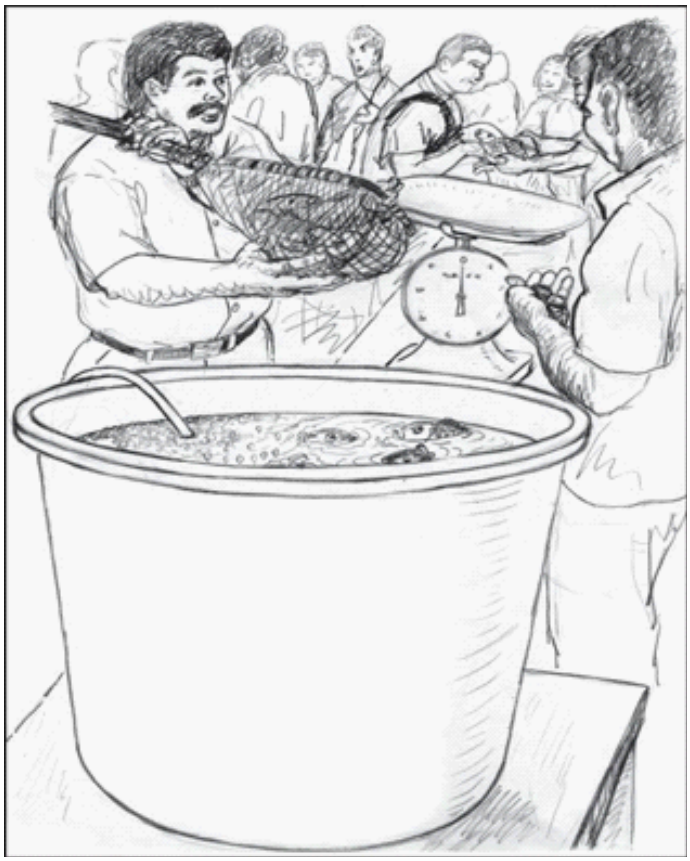


**Figure 17 - Selling of fish at the market**

The method chosen for selling the fish will be dependent on the locality and on the type of equipment that is available for handling the fish. In Fiji, for example, the most common method of selling fish is whole and live in tanks.

Be creative about marketing the fish so that people will want to buy the fish and be willing to pay a good price. For example, tilapia could be sold at the market or at fairs cooked as a parcel with cassava, onions, tomatoes and lemon. Plan to harvest at Christmas, special holidays or government pay-days when people want to buy fish. Display them with leaves and plants around the fish so they look attractive. Keep flies off them. Buy ice to keep them chilled. Keep the fish alive as long as possible. Fresh fish taste and look better than frozen fish, and live fish are best of all.

In villages, advertise the day of fish harvest so that people know in advance and come prepared to buy the fish. Ensure that people know where the fish will be sold. For example, put a sign on the main road. Inform nearby villages about fish sales before the harvest day. Take orders for fish. Consider buying a portable tank and an aerator so that live fish can be sold at the market.

### 4.11.67 Record keeping

A fish farm is a business; therefore all activities on the farm should be recorded. Proper record keeping is a valuable management tool. It is the means to measure the cash input and cash output, in order to evaluate and improve the farm performance and plan for future operations.

The records will assist in showing the farmer how much money can be made from the business (income), and how much money can be saved and spent on the running of business for the next pond cycle. The records that should be kept include both farm activities such as stocking, feeding, sample weighing, fertilizing and harvesting and natural phenomena such as fish kills, period of low DO, rainy days, floods etc. These records over a number of years will show the effects of different management methods on profitability. For example, the farmer can examine the records to pinpoint occurrences of lower growth rates, low

feed utilization, or fish deaths.

**4.11.68 What should be recorded?**

At the very least, record the number of fish and the total weight of fish harvested from the pond. This can be compared to the record of how many fish were stocked into the pond at the beginning of the pond cycle and used to estimate the percentage survival of fish.

A Farm Logbook should also be maintained. Enter any daily observations such as dead fish, water temperature, water colour, water requirements, pond stocking dates, fish numbers stocked and their weight, daily feed rations, sampling dates, sampling data, harvesting dates, fish numbers harvested and their weight, total food requirements, and other relevant notes or data.

(Source : Nandlal & Pickering, 2006)

*Appendix 1*

# Pond Record Sheet

Name of farm: _____ Pond No.:_____ Area: _____$m^2$

Fingerling source: _____ Stocking date: _____ No. stocked: _____

Stocking density: _____/$m^2$ Average body weight (ABW): _____ g Total wt: _____ kg

Feed supplier: _____ Type of feed: _____ Type fertilizer: _____

Daily feed ration (DFR):_____kg Fertilizer (kg per week):_____

## *Fish sampling data:*

| Sampling date | Days from last sampling | ABW of fish (g) | New DFR (g) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

## *Fish harvesting data:*

| Harvest date | No. days of grow-out | No. of fish | ABW of fish (g) | Weight harvested (kg) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Total fish harvested: _____ kg Selling price: _____ /kg Total sales: _____

Total feed used: _____ kg Feed price: _____ /kg Total feed cost: _____

FCR: _____

Total fertilizer used: _____ kg Fertilizer price: _____ /kg Total fert. cost: _____

Fish survival: _____ % Fish losses: _____ kg Fish given free: _____ kg

Market fee: _____ Transport cost: _____ Labour cost:_____

Other costs:_____

# Useful formulae

**Percentage survival:**

$$\% \text{ survival} = \frac{\text{Number of fish harvested} \times 100}{\text{Number of fish stocked}}$$

For example:

If you put in 1000 fish and harvested 900, then % survival was 900/1000 x 100 = 90%. A good survival rate is 90% or more.

***Average body weight:***

$$\text{ABW} = \frac{\text{Total weight of fish in a random sample}}{\text{Number of fish in sample}}$$

For example:

If you caught 500 fish and the weight of the fish was 75kg, then ABW was 75/500 = 0.150kg, so ABW is 150g.

***Daily feed ration:***

DFR = Feeding rate x ABW x Total number of fish

Note: Feeding rate is the percentage of fish average body weight to be given as food daily (e.g. 5% of body weight).

***Total feed requirement:***

TFR = DFR x Feeding duration

***Food conversion ratio:***

$$\text{FCR} = \frac{\text{Amount of food given}}{\text{Fish weight increase}}$$

# Chapter 4.12 | Disaster Hive Management in Fiji

# Hive Management for Disaster

### 4.12.1 Flood can reach unexpected levels

1. Move hives from low lying areas to flood free heights.
2. Watch out for other drains, creeks and water ways that might flood the new location.
3. Landslides could also happen so select sites that are safer.
4. Move the hives to safer areas before disaster happens.

### 4.12.2 Protect from strong winds

As cyclone season approaches, fasten the hives firmly with ropes or belts to prevent from capsized of blowing out into pieces. Ensure hive stands are firmly anchored in the ground.

### 4.12.3 Moving the hives

- Fasten hives properly before moving.
- Move hives early in the morning or late in the afternoon to reduce loss of field bees.

- Do not move hives during the day time.

### 4.12.4 Method of moving hives

1. Use wheel barrows, one hive at a time
2. Use stretches
3. Use trailers or pickup trucks if road access is good.
4. Handle the hives gently and work smartly.
5. Prevent hives from dropping, bangs or accidents

### 4.12.5 Feeding the colonies

1. Continuous rain normally exhausts the production of nectars.
2. Less flowering leads to lack of feed for bees.
3. The reserve honey in the hive is ultimately used.

### 4.12.6 How to survive the colonies

- Dry sugar feeding

- Sugar syrup feeding
- Sugar candy feeding

**Don't let the bees starve to death**

- Ensure there is enough feed in the hive to take through the bad weather.
- Check and top up feed every 3 days. Survive your bees for the next production season.

PART II

# FINANCIAL INFORMATION

# CHAPTER 5.0
# CROP REVENUE

## Introduction

The information in this Chapter is intended to give a summary of the expected national prices for a range of commodities grown in Fiji. The list is not fully comprehensive, but should include most of the common crops.

It is derived from the Ag-Trade - Economic Planning & Statistics Division, of the Ministry of Agriculture, who are exclusively responsible in the collation and updating of market prices of Agricultural commodities throughout the country, and should be used with a measure of good judgment and sagacity.

**5.1**

| Category | Price per kg | | | |
|---|---|---|---|---|
| **Roots** | **Jan-14** | **Feb-14** | **Mar-14** | **Apr-14** |
| Cassava | $1.35 | $1.25 | $1.15 | $1.02 |
| Dalo Other Varities | $1.49 | $1.34 | $1.31 | $1.21 |
| Dalo-Tausala | $1.47 | $1.49 | $1.40 | $1.30 |
| Ginger | $3.17 | $3.73 | $3.33 | $3.13 |
| Kumala | $1.58 | $1.75 | $1.65 | $1.62 |
| Dalo ni Tana | $1.50 | $0.95 | $1.19 | $1.61 |
| Tivoli | 0 | $1.78 | 0 | 0 |
| Yam (Uvi) | $1.50 | $1.76 | $1.76 | $2.22 |
| Waka Roots | $32.16 | $32.58 | $33.38 | $31.44 |
| Lewena | $24.05 | $23.71 | $23.88 | $26.50 |
| Vanuatu Waka | $26.67 | $25.00 | $26.17 | $28.00 |
| Vanuatu (Lewena) | $25.00 | $25.00 | $30.83 | $29.83 |

*(Source - Ag Trade, EP&S - 2014)*

**5.2**

| *Vegetable Crops* | *In Season* | *Off Season* |
|---|---|---|
| | *May 2013 to November 2013* | *Dec 2013 to April 2014* |
| Capsicum | $11.65/kg | $14.71/kg |
| Carrot | $2.72/kg | $12.93/kg |
| Chillies | $7.96/kg | $6.24/kg |
| Chinese Cabbage | $1.7/kg | $2.50/kg |
| Cucumber | $1.86/kg | $2.32/kg |
| Duruka | $4.30/kg | $6.90 |
| Eggplant | $1.92/kg | $2.25/kg |
| English Cabbage | $2.71/kg | $4.79/kg |

| | | |
|---|---|---|
| French Bean | $3.12/kg | $3.83/kg |
| Lettuce | $5.67/kg | $8.18/kg |
| Long Bean | $3.22/kg | $2.71/kg |
| Okra | $2.82/kg | $3.27/kg |
| Pumpkin | $1.60/kg | $1.95/kg |
| Radish | $1.28/kg | $1.32/kg |
| Tomatoes | $5.14/kg | $6.96/kg |

*(Source: Ag Trade, Min. of Agriculture, 2014)*

5.3

| Category | Price per kg | | | |
|---|---|---|---|---|
| **Cereal** | **Jan-14** | **Feb-14** | **Mar-14** | **Apr-14** |
| Maize | $3.45 | $2.52 | $3.76 | $2.50 |
| Rice - Paddy Local | $0.00 | $1.50 | $0.00 | $0.00 |

*(Source: Ag Trade, Min. of Agriculture, 2014)*

**5.4 Pulses** [price per kg]

| | | |
|---|---|---|
| Pigeon pea | $3.50 | - 4.10/kg |
| Peanuts | $4.50 | - 5.50/kg |
| Urd | $4.00 | - $5.00/kg |
| Cowpea | $4.50 | - $5.00/kg |
| Mung pea | $3.50 - $4.50/kg | |

**5.5 Fruits** [Farm-gate prices]

| | | |
|---|---|---|
| Pineapple | - | $500/ton |
| Passionfruit | - | $1000/ton |
| Mango | - | $800/ton |
| Citrus | - | $700/ton |
| Papaya | - | $1500/ton |

**5.6**

| Category | Price per kg | | | |
|---|---|---|---|---|
| **Tree Crops** | **Jan-14** | **Feb-14** | **Mar-14** | **Apr-14** |
| Avocado | $0.00 | $3.11 | $2.42 | $2.95 |
| Banana (Green) | $1.93 | $1.89 | $2.04 | $1.88 |
| Banana (Ripe) | $1.93 | $1.78 | $1.65 | $1.72 |
| Coconuts (dozen) | $4.35 | $4.55 | $5.75 | $4.39 |
| Ivi - Chestnut Cooked | $3.00 | $3.31 | $3.63 | $5.44 |
| Ivi - Chestnut Fresh | $2.75 | $3.23 | $3.02 | $3.25 |
| Jackfruit | $2.01 | $3.19 | $3.79 | $3.47 |
| Lemon | $2.48 | $2.08 | $1.73 | $1.83 |
| Lime | $3.30 | $2.17 | $1.94 | $1.84 |
| Mango | $2.80 | $2.33 | $2.25 | $0.00 |
| Pawpaw | $2.63 | $2.81 | $2.76 | $2.47 |

***Source - Ag-Trade, Ministry of Agriculture, 2014.***

5.7 Sugar

| | | |
|---|---|---|
| 5.7.1 2013 Price | - | $82/ton |
| 5.7.2 2014 Forecast Price | - | $65/ton |
| 2013 (TCTS) Ratio of Cane to Sugar | - | 9ton Cane:1ton Sugar |

***(Source : Railoa, FSC, Lautoka)***

# CHAPTER 6.0
# LIVESTOCK REVENUE

## INTRODUCTION

The information collated for this chapter is basically designed to give an impression of prices of some livestock commodities produced in Fiji. The data were collated through interviews and surveys based on the consensus and agreement of the Managers and Retailers.

Prices may differ outside Viti Levu, but consumers should bear in mind that prices entirely depend on the buyers. Particular attention should be given to any meat schedule as occasionally occurs.

### 6.1 *Buying & Selling Prices of The Fiji Meat Industry Board w.e.f of February/2014*

#### 6.1.1 FMIB Buying Prices

| *Grade* | *Buying Price* |
|---|---|
| I (Bull) | $4.80/kg Dressed Weight |
| II | $4.60/kg Dressed Weight |
| III | $2.90/kg Dressed Weight |

***Cattle***

***Pork***

| *Class* | *Weight* | *Buying Prices* |
|---|---|---|
| Porker | 15 - 30 kg | $7.00/kg Dressed |
| | 31 - 50kg | $7.00/kg Dressed |
| Baconer | 51 - 70kg | $6.00kg Dressed |
| | 71 - 85kg | $5.00kg Dressed |
| | 86 - 100kg | $4.00/kg Dressed |
| Culled Sows | >150kg | $4.00/kg Dressed |
| All Class | >101kg - 180kg | $3.20/kg Dressed |
| All Class | >180kg | $2.50/kg Dressed |

Goat

| *Class* | *Buying Prices* |
|---|---|
| Buck | $11.00/kg Dressed |
| Doe | $8.50/kg Dressed |

| *Class* | *Buying Prices* |
|---|---|
| Hogget | $12.00/kg Dressed |
| Rams | $10.00/kg Dressed |
| Ewes | $8.00/kg Dressed |

Sheep

6.1.2 FMIB Selling Prices

| *Grade* | *Selling Prices* |
|---|---|
| I (Bull) | $7.50/kg Dressed Weight |
| II | $7.40/kg Dressed Weight |
| III | $5.20/kg Dressed Weight |

***Cattle***

***Pork***

| *Class* | *Weight* | *Selling Prices* |
|---|---|---|
| Porker | 15 - 30 kg | $12.60/kg Dressed |
| | 31 - 50kg | $12.60/kg Dressed |
| Baconer | 51 - 70kg | $10.25/kg Dressed |
| | 71 - 85kg | $8.75/kg Dressed |
| | 86 - 100kg | $7.60/kg Dressed |
| Culled Sows | >150kg | $7.60/kg Dressed |
| All Class | >101kg - 180kg | $6.10/kg Dressed |
| All Class | >180kg | $5.00/kg Dressed |

***Goat***

| *Class* | *Selling Prices* |
|---|---|
| Buck | $14.20/kg Dressed |
| Doe | $11.50/kg Dressed |

***Sheep***

| *Class* | *Selling Prices* |
|---|---|
| Hogget | $17.25/kg Dressed |
| Rams | $14.00/kg Dressed |
| Ewes | $11.50/kg Dressed |

6.2 Butcher Prices for

| **Product** | **Price/kg ($)** |
|---|---|
| Beef Liver | 7.95/kg |
| Beef Mince | 10.25/kg |
| Beef Sausage | 8.50/kg |
| Beef Trype | 4.50/kg |
| Brisket | 8.55/kg |
| Chopsuey Meat | 11.99/kg |
| Gravy Beef | 11.50/kg |
| Kidney | 4.50/kg |
| Meaty Bones | 7.95/kg |
| Ox Heart | 7.50/kg |
| Ox Toungue | 7.50/kg |
| Ox Tail | 9.25/kg |
| Round Steak | 11.99/kg |
| Rumpsteak | 13.50/kg |
| Soup Bone | 2.80/kg |
| Soup Meat | 9.99/kg |

a) Beef

(Price list is quoted from Tebara Butcher)

Pork

| Product | Price/kg ($) |
|---|---|
| Belly Roast | 13.50/kg |
| Leg Chops | 12.95/kg |
| Leg Roast | 12.50/kg |
| Loin Chops | 13.90/kg |
| Loin Roast | 13.90/kg |
| Shoulder Chops | 12.50/kg |
| Shoulder Roast | 12.15/kg |
| Not all butchers sell Pork | |

**c) Sheep (Imported)**

| Product | Price/kg ($) |
|---|---|
| Lamb Neck | 10.99/kg |
| Lamb BBQ Chops | 15.99/kg |
| Lamb Shank | 16.99/kg |
| Lamb Chops | 14.66/kg |

**d) Dairy**

Wholemilk - $1.00/litre premium grade
- $0.85/litre 1st grade
- $0.70/litre 2nd grade

Excess cream in wholemilk (over 3.4% Butterfat) $6.32/kg on excess fat.

(Current Price with Fiji Dairy Limited)

**e) Meat Birds (Broilers)**

| Contract Growers ($/kg liveweight) | Processors ($/kg liveweight) | Retailers ($/kg Live-weight) | Roadside ($) |
|---|---|---|---|
| 2.73 | 3.70/kg | $4.50/kg | $10 - $15 per bird Average weight 1.5kg |
| | | | |

**f) Layers**

| Eggs | Wholesale Prices ($) | Retail Prices ($) |
|---|---|---|
| 720g - 800g | $11.00/tray | $13.00/tray |
| 600g - 660g | $9.00/tray | $10.00/tray |
| <600gram | $7.00/tray | $8.50/tray |
| | | |

Culled Birds - $7 - $9/live bird

**g) Honey** - $15 - $20/litre

# CHAPTER 7.0
# FARM EXPENDITURE

## 7.1 INTRODUCTION

Government is fully committed to give all workers the right to a just minimum wage as required under Section 33 of the 2013 Constitution which states;

1) The State must take reasonable measure within its available resources to achieve the progressive realization of the right of every person to work to a just minimum wage.
2) In applying any right under this section, if the State claims that it does not have the resources to implement the right, it is the responsibility of the State to show that the resources are not available.

In light to this, Fiji's minimum wage of $2 (US $1.07) per hour came into force on 1st March,2014. The National Minimum Wage (NMW) had been gazetted and all relevant employers must adjust their workers' wage level and employment conditions to comply with the NMW Regulations and the Employment Relations Promulgation (ERP).

The main objective of this major wage policy is to alleviate poverty among the most marginalized workers in the informal and formal sectors. It is to build a better Fiji for these workers who have been disadvantaged and disregarded for a long period of time. This is in-line with the Government's commitment under the Peoples Charter for Change, Peace and Progress (PCCPP) on reducing poverty to a negligible level by 2015 while enhancing workplace and productivity.

All entitlements and fundamental principles of rights at work under the ERP are still applicable to all workers covered under the NMW Regulations. For example, workers entitlement such as annual leave, public holiday leave, maternity leave, sick leave, bereavement leave and all other benefits provided under the ERP must be fully awarded when due.

A spot fine of $100 will be issued if employers refuse to follow any part of the NMW Regulations and further penalties will be issued upon breach of the Regulations. On conviction, an employer is liable to a fine of $20,000 or two (2) year imprisonment or both.

## 7.2 CONTRACT CHARGES

Below are some of the operation charges which the Government levied based on Government award rates.

| | | |
|---|---|---|
| Ploughing | - | $27.94/hour |
| Harrowing | - | $27.94/hour |
| Rotovation | - | $29.92/hour |
| Ridging | - | $27.94/hour |
| Digger Rate | - | $29.92/hour |

| | | | |
|---|---|---|---|
| Private Contractor | : | Central Division | : $60 - $75/hour |
| | | Northern Division | : $70-$80/hour |
| | | Western Division | : $70 - $80/hour |

***There is an additional charge on the cartage of the machine and the contractor always dictate it from the distance of carting the machine from Point A to Point B.***

## 7.3. ANIMAL HEALTH

### 7.3.1 VETERINARY PRODUCTS w.e.f APRIL 2014

| DRUGS/EQUIPMENTS | UNIT | PRICE ($) |
|---|---|---|
| Antibiotics - Parental | | |
| Norocillin S A | 100ml | 16.00 |
| Norocillin L A | 100ml | 20.00 |
| Oxytet 200 L A | 100ml | 35.50 |
| Trisoprism 480 Injection | 100ml | 36.00 |
| Engeymycin 100 (Oxytet 200 SA) | 100ml | 51.00 |
| Excenel RTU | 100ml | 142.70 |
| | | |
| Antibiotics - Oral | | |
| Moxylan Drops 15mls | 15ml | 6.80 |
| Amoxycillin 200mg | 1000tab | 300.00 |
| Amoxycillin 200mg | 500tab | 160.00 |
| Amoxycillin 400mg | 500tab | 300.00 |
| Amoxycillin AFS Powder | 1kg | 370.00 |
| Oxymav 100 Powder | 200g | 45.00 |
| CTC Echo Powder (Chortet) | 200g | 70.00 |
| Sulphaquin | 1ltr | 81.00 |
| Tricon Powder | 2kg | 360.00 |
| Trimazine Bolus | 50tabs | 50.00 |
| Tylan Soluble CD | 100g | 40.00 |
| Tylan Powder | 1kg | 300.00 |
| | | |
| Antibiotics Intramammary | | |
| Cepravin Lactating Cow 3g | each | 10.00 |
| Cepravin Lactating Cow 3g | each | 8.00 |
| | | |
| Antibiotics Others | | |
| Antiseptic Dusting Powder | 3kg | 228.00 |
| Apex Ear Drops 15ml | each | 15.00 |
| Tricin Eye & Ear Ointment | each | 12.00 |
| Utozyme Pessaries 10's | 15ml | 40.00 |
| Canaural Compositum | tab | 11.00 |
| | 15ml | 14.60 |
| Anti Fungal Agents | | |
| Canestan Cream 20g | each | 5.00 |
| Metrogyl Tabs | 21 tabs | 3.00 |
| | | |
| Alimentary System-Antispasmodic | | |
| Buscopan Compositum | 100ml | 178.00 |
| | | |
| Laxatives, Puragatives, Lubricants | | |
| Liquid Paraffin | 500ml | 18.00 |
| Magnesium Sulphate | kg | 5.50 |
| Scourban | 2 ltr | 174.00 |
| Tribrissen Suspension | 200ml | 65.00 |
| Anaesthetics | | |
| Ketamil | 10ml | 7.50 |
| Lignocaine 2% | 100ml | 9.00 |
| Lignomav 2% Plain | 100ml | 9.00 |
| Nemtabul | 100ml | 64.90 |
| Ketmav 100 | 20ml | 13.25 |
| Pentobarbitone | 100ml | 46.00 |

| | | |
|---|---|---|
| | | |
| Analgesics | | |
| Ketofen Tabs | each | 1.05 |
| | | |
| Hyppnotics & Tranquillizers | | |
| Atropine (Atrosite) | 50ml | 9.40 |
| Acemav 10mg (Promex 10) Inj | 20ml | 6.50 |
| Acemav Injection 2mg (Promex 2) | 10ml | 5.60 |
| Promex Tabs 25mg | 150 tabs | 39.80 |
| Xylazil 20 | 50ml | 35.00 |
| Xylazil 100 | 50ml | 75.00 |
| Stresnil Injection (Pigs) | 100ml | 111.00 |
| | | |
| Antidotes | | |
| Reverzine L A Injection | 20ml | 29.90 |
| Dopram | 20ml | 130.00 |
| | | |
| Anthihistamines | | |
| Niramine | 50ml | 19.50 |
| Aminyllin Tabs 100g | 100 tabs | 5.00 |
| Millophylline Tabs | 100 tabs | 13.00 |
| | | |
| Clotting Agents | | |
| Vasolamin 5% | 50ml | 12.00 |
| Vasolamin 10% | 50ml | 55.00 |
| | | |
| Euthanasiates | | |
| Lethabarb | 450ml | 320 |
| | | |
| Urinogenital System | | |
| Oxytocin/Syntocin | 50ml | 15.00 |
| Duphospasmin (Planipart) | 100ml | 73.90 |
| | | |
| Endocrine Sex Hormones | | |
| Stillboestrol Tabs | 1000tabs | 17.60 |
| Supress 20mg | 200 tab | 85.00 |
| Surpress 40mg | 200 tab | 60.00 |
| Estrumate | 20ml | 41.90 |
| | | |
| Corticosteroids & Related Compounds | | |
| Betsolan Tabs 0.25g | 1000 tabs | 50.70 |
| Colvasone Injection | 50ml | 10.50 |
| Dexasone Injection | 50ml | 30.00 |
| Microlome 5mg (replaces Betsolan) | 1000 tabs | 66.00 |
| | | |
| Musculoskeletal System - Anti Inflammatory Agents | | |
| Butsyl Injection (PBZ) | 100ml | 18.80 |
| Rimadyl Injection | 20ml | 68.00 |
| Rimadyl Tabs 100mg | 14's | 35.10 |
| Flunixil Injection | 50ml | 39.00 |
| Flunixil Injection | 100ml | 92.00 |
| Beautamav Tabs 100mg(Butalone Tabs) | 100's | 22.65 |
| Lotagen Concetrated | 100ml | 47.50 |
| | | |
| Nutrition & Metabolism Electrolytes | | |
| Lectade | 12 sachetts | 84.00 |
| Dextrose Parnell | 480ml | 15.15 |
| Hartman's Solution | 1 ltr | 8.00 |
| | | |
| Iron & Haemopoietic Agents | | |

| | | |
|---|---|---|
| Pigdex 100 Injection | 200ml | 68.45 |
| Ferron 200 + B12 Injection | 100ml | 60.00 |
| Ferron 200 + B12 Injection | 200ml | 80.00 |
| Anaemex Iron Injection | 100ml | 66.00 |
| | | |
| Vitamin, Mineral & Nutritional Additives | | |
| Activate Charcoal | 100g | 19.20 |
| Stressol | 500g | 100.00 |
| Vitamin B Complex Injection | 100ml | 26.00 |
| Calcigol Plus | 350ml | 17.00 |
| Unical Flour Pouch (Calcigol Plus) | | 20.00 |
| Charcotabs 250mg | 60's | 30.00 |
| Multibex Injection | 100ml | 37.80 |
| Multi Mineral Block | 20kg | 50.00 |
| | | |
| Parasiticides Internal - Cattle/Sheep & Goats | | |
| Fenbendazole Powder | kg | 120.00 |
| Fencare 100 | 5ltr | 287.30 |
| Ferbendazole 2.5 | 20ltr | 400.00 |
| Ivomec Injection Cattle | 50 ml | 410.00 |
| Nilverm Oral | 20ltr | 300.00 |
| Fenbendazole 100 | 5 ltr | 291.00 |
| Noromectin Injection | 500 ml | 335.00 |
| Noromectin Oral Sheep Drench | 20 ltr | 570.00 |
| Levicare | 1 ltr | 33.00 |
| | | |
| Parasiticides Internal - Pig & Poultry | | |
| Nilverm Pig & Poultry | 2.5ltr | 200.00 |
| Toltro | 500g | 46.25 |
| Solquin | 500g | 60.00 |
| Kilverm Pig & Poultry | 2.5ltr | 85.00 |
| | | |
| Parasiticides Internal - Dogs & Cats | | |
| Telmin Horse Paste | 20g | 15.25 |
| Equinox Horse Paste | 32.6g | 25.00 |
| Oximinth Plus Horse Paste | 25g | 25.00 |
| | | |
| Water Soluble | | |
| Amprolium 200 | 1kg | 140.00 |
| | | |
| Parasticides Internal Dogs & Cats | | |
| Drontal Cat 4kg Tabs | 60's | 612 |
| Drontal Cat 6kg Tabs | 50's | 590 |
| Drontal Dog 10kg Tabs | 100's | 1180 |
| Drontal Dog 35kg Tabs | 70's | 1925 |
| Drontal Pup 3kg Tabs | 50's | 250 |
| Cancare Tabs | 250's | $125.00 |
| Ambex Tabs 10kg | 50's | $220.00 |
| Ambex Tabs 5kg | 100's | $120.00 |
| Dimmitrol 200mg tabs | 100's | $14.00 |
| Heartguard + Blue [1-11kg] 6 's Small | Pkt | $60.00 |
| Heart guard+ Green [12-22kg] 6 ' Meg | Pkt | $72.00 |
| Heartguard+Brown [23-45kg] 6 's Large | pkt | $84.00 |
| | | |
| PARASITICIDES EXTERNAL | | |
| Fido's Flea Powder 200g | 200g | $8.20 |
| Fido's Rinse Concentrated | 5ltrs | $366.00 |
| Malathion 50 EC | 1ltrs | $34.00 |
| Malathion 50 EC | 4ltrs | $98.00 |
| Malathion 50 EC | 5ltrs | $170.00 |

| | | |
|---|---|---|
| Malathion 50 EC | 20ltrs | $520.00 |
| Quick Kill Rinse Conc 5ltr | 5ltrs | $210.00 |
| Frontine Spray | 100mls | $20.35 |
| Frontine Spray | 250mls | $37.30 |
| Frontline Dog+Topspot Small 6 's | Pkt | $126.00 |
| Frontline Dog + Topspot Medium 6 's | Pkt | $132.00 |
| Frontline Dog + TGopspot Large 6 's | Pkt | $138.00 |
| Taktic EC H/Spray Cattle | 400ml | $80.00 |
| | | |
| VACCINES | | |
| Vanguard 5 | Dose | $11.50 |
| Tetanus Antitoxin | 10ml | $187.00 |
| Tetanus Toxoid (Equivac T) | 1ml | $47.00 |
| Tetanus Toxoid (Equivac T) | 10ml | $360.00 |
| Leptoguard [canine] | Dose | $10.50 |
| Felovax 4 Vaccines [cat] | Dose | $9.00 |
| Porcine Parvac [Pig] | 100mls | $244.00 |
| Protech C4 + 21 | Dose | $35.00 |
| | | |
| ANTISEPTIC & DISINFECTANTS | | |
| Chloerhex C | 5ltr | $133.70 |
| Clinikill | 5ltr | $37.00 |
| Iodine Mitis | 500ml | $75.00 |
| PVP – Iodine | 5ltr | $170.00 |
| Stericide | 10ltr | $80.00 |
| Lotagen Concentrated | 100mls | $47.50 |
| Methylated Spirit | 1ltr | $6.50 |
| Methylated Spirit | 5ltr | $42.00 |
| Formalin 40% | 5ltr | $59.00 |
| Salvon | 500mls | $10.00 |
| | | |
| SPRINGES & NEEDLES SYRINGES | | |
| Disposable Syringes 60ml | Each | $1.65 |
| Disposable Syringes 50ml | Each | $1.40 |
| Disposable Syringes 20ml | Each | $0.80 |
| Disposable Syringes 10ml | Each | $0.50 |
| Disposable Syringes 5ml | Each | $0.35 |
| Disposable Syringes 3ml | Each | $0.20 |
| Disposable Syringes 1ml | Each | $0.20 |
| Vacutainer Plain 10ml | 100's | $37.70 |
| Vacutainer Edta 10ml | 10ml100's | $32.00 |
| Vacutainer Edta 5ml | 100's | $31.00 |
| Vacutainer Holder | each | $0.45 |
| NEEDLES | | |
| Disposal Needle 18g*1"100's | each | $0.10 |
| Disposal Needle 18g*1.5100's | each | $0.10 |
| Disposal Needle 19g*1" | each | $0.10 |
| Disposal Needle 19g*1.5" | each | $0.10 |
| Disposal Needle 21g*1" | each | $0.10 |
| Disposal Needle 21g*1.5" | each | $0.10 |
| Disposal Needle 23g*1" (1 ¼ ") | each | $0.10 |
| Disposal Needle 25g *1" | each | $0.10 |
| Disposal Needle 26g* 1" | each | $0.10 |
| Vacutainer Needle 18g x 1" | 100 'S | $24.00 |
| | | |
| SUTURE NEEDLES | | |
| Rounded Bodied Curved No. 4 | Pkt | $4.85 |
| ½ Circle Round Body No.6 | Pkt | $4.85 |
| ½ Circle Triangular No.10 | Pkt | $2.70 |
| ½ Cirle Triangular No.14 | Pkt | $2.70 |

| | | |
|---|---|---|
| ½ Circle Round Body No. 14 | Pkt | $2.70 |
| ½ Circle Triangular No.16 | Pkt | $2.70 |
| ½ Curved Triangular No.4 | Pkt | $2.70 |
| Curved Triangular No. 6 | Pkt | $4.85 |
| ½ Curved Triangular No. 6 | Pkt | $4.85 |
| ½ Curved Triangular No. 10 | Pkt | $4.85 |
| Curved Triangular No. 12 | Pkt | $2.70 |
| Curved Triangular No.4 | Pkt | $2.70 |
| Straight Triangular No.6 | Pkt | $2.70 |
| Straight Triangular No. 8 | Pkt | $4.85 |
| Straight Triangular No.12 | Pkt | $2.70 |
| ½ Curved Triangular NO.14 | Pkt | $5.15 |
| ½ Curved Triangular No.16 | pkt | $5.15 |
| | | |
| IV ADMIN CATHETERS & SET | | |
| 18g | each | $3.00 |
| 22g | Each | $3.00 |
| 24g | Each | $3.00 |
| Admin Solution | Each | $2.00 |
| | | |
| SUTURE MATERIALS CATGUT | | |
| (ABSORBABLE/INTERNAL SUTURES) | | |
| Chromic Catgut Met 3[2] monosyn | 75cm | $2.50 |
| Chromic Catgut Met [4]2 metric fiol | 75cm | $8.85 |
| Chromic Catgut Met 5[foil] | 1.5cm | $3.80 |
| Chromic Catgut Met 6[foil] | 1.5cm | $3.80 |
| Chromic Catgut Met 7[foil] | 1.5cm | $3.80 |
| Chromic Catgut Met 4[0] [Cassette] | 25m | $106.00 |
| Chromic Catgut Met 5[1] [Cassette] | 25m | $125.55 |
| Chromic Catgut Met 6[2] [Cassette] | 25m | $125.55 |
| | | |
| NYLON (EXTERNAL/NON ABSORABLE SUTURES | | |
| Vetgafil Light 0.20mm | 50m | $40.00 |
| Vetafil Medium 0.30mm | 50m | $50.15 |
| Vetafin Heavy 0.40mm | 50m | $58.00 |
| Supramid Met 5 USP 2 | 50m | $100.00 |
| Supramid Met 4 USP 1 | 75m | $97.50 |
| Supramid Met 6 USP 3 | 50m | $100.00 |
| Nylon Suture 4[0] [Foil] | 45cm | $9.65 |
| Premilene Met 4[1] | 75cm | $329.40 |
| | | |
| COTTON WOOL | | |
| Cotton Wool – Large 375g | Roll | $9.00 |
| Cotton Wool – Large 500g | Roll | $9.00 |
| | | |
| BANDAGES | | |
| Cotton Gauze – Small 5cm x 5cm | each | $1.50 |
| Cotton Gauze – Large 7.5cm x 5cm | Each | $3.60 |
| Dynacast – Small – [10cm x 3.6m] | Each | $19.00 |
| Dynacast – Large [12.5cm x 3.6m] | Each | $21.00 |
| Elastoplast [7.5cm] | Each | $12.00 |
| Elastoplast [5cm] | Each | $2.50 |
| Gauze Swabs [10cm x 10m x 8ply] | 100's | $7.00 |
| Gauze Swabs [7.5cm x 7.5m x 8ply] | 100's | $4.50 |
| Micropore Tape [7.5cm x 9mt] | Roll | $3.70 |
| Pranet Dressing | 36's | $10.80 |
| Vetrap | Each | $11.00 |
| | | |
| ***GLOVES*** | | |
| P.D Gloves [Krutex] Shoulder length | 100's | $48.00 |

| | | |
|---|---|---|
| Disposal Gloves [Large] Latex | 100's | $20.00 |
| Disposal gloves [Medium] Latex | 100's | $20.00 |
| Surgical Gloves [No. 6,7,8] Gmmex | Pair | $1.45 |
| Disposable Gloves Triflex | 50's | $11.75 |
| | | |
| ***EQUIPMENT SURGICAL*** | | |
| Forceps – Haemostatic | each | $4.00 |
| Forceps 6" 15cm | each | $8.00 |
| Needle Holders | each | $11.00 |
| Scapel Handle No. 3/ No 4 | each | $6.90 |
| Scaple Plade No . 24 | 100'S | $16.00 |
| Scaple Plade No. 11 | 100'S | $12.00 |
| Scissors S/B 12.5cm | Each | $7.50 |
| Surgical Drapes – 112 x 176cm (Fen 13 x 6cm) Large | Each | $60.00 |
| Surgical Drapes – 91 x 91cm (Fen 14 x 6cm) Medium | Each | $45.00 |
| Surgical Drapes – 85 x 80cm (Fen x 5cm) Small | Each | $45.00 |
| Forceps 20cm | Each | $10.70 |
| Artery Forceps 12.5cm | Each | $8.80 |
| Artery Forceps 20cm | Each | $10.70 |
| | | |
| ***GENERAL*** | | |
| Allflex Ear Tags – Large Male | Each | $1.70 |
| Allflex Ear Tags – Large Female | Each | $1.40 |
| Allflex Ear Tags – Medium Male | Each | $1.50 |
| Allflex Ear Tags – Medium Male | Each | $1.50 |
| Allflex Ear Tags Small Male | Each | $1.30 |
| Allflex Ear Tags Small Female | Each | $1.25 |
| Allflex Ear Tags Applicator | Each | $75.00 |
| Allflex Marker Pens | Each | $25.00 |
| Allflex Tag Pins | Each | $4.00 |
| Bull Ring 3" | Each | $31.00 |
| Calving Rope Nylon | Each | $55.00 |
| Dog Collars – Small [35cm] | Each | $7.00 |
| Dog Collars – medium [45cm] | Each | $10.00 |
| Dog Collars – large [55cm] | Each | $12.00 |
| Drenching Gun – 60ml-(NJ PHILLIPS) without back – pack | Set | $260.00 |
| Drenching Gun-30 ml(SIMCRO)with back -pack | Set | $255.00 |
| Drenching Gun-30 ml-(NJ PHILLIPS)without back-pack | Set | $250.00 |
| Drenching Gun-20 ml-(NJ PHILLIPS)with back-pack | Set | $263.00 |
| Drenching Gun-20 ml-(NJ PHILLIPS)without back-pack | Set | $235.00 |
| D/Gun Container (Back pack) 2.5lt (*for NJ PHILLIPS gun*) | Each | $40.00 |
| D/Gun Container (Back pack) 5lt (*for NJ PHILLIPS gun*) | Each | $45.00 |
| D/Gun-Hi Flo-Sheep (genesis) | Each | $106.00 |
| Elastrator Applicator | Each | $43.00 |
| Elastrator Rubber Rings | 500's | $25.00 |
| Embroyotomy Wire – 12m | Each | $55.00 |
| Footrot Shears | Each | $46.40 |
| Hot Knife | Each | $19.00 |
| Measuring Cylinders | Each | $6.00 |
| Multi Ear Tags | Each | $0.50 |
| Multi Ear Tags Applicator | Each | $50.00 |
| Muzzle - 0 | Each | $7.00 |
| Muzzle – 1 [Kramar Brand] | Each | $21.00 |
| Muzzle – 2 [Kramar Brand] | Each | $17.10 |
| Muzzle – 3 [Kramar Brand] | Each | $21.00 |
| Muzzle – 4 [Kramar Brand] | Each | $18.50 |
| Muzzle – 5 [Kramar Brand] | Each | $29.00 |
| Pig Drinking Nipples | Each | 15.00 |
| Plastic Bottles – Small 4 oz 120mls | Each | $0.50 |
| Plastic Bottles – Medium 8 oz 240mls | Each | $0.75 |

| | | |
|---|---|---|
| Plastic Bottles – 300mls | Each | $0.80 |
| Plastic Bottles – 1ltr | Each | $1.00 |
| Plastic Dispensing Bags 100 x 75mm | 1000's | $12.00 |
| Plastic Dispensing Bags 150 x 90mm | 1000's | $28.00 |
| Plastic Dispensing Bags 90 x 50mm | 1000's | $20.00 |
| Plastic Dispensing Bags 180 x 170mm | 1000's | $21.00 |
| Raddles Assorted Colours | Each | $12.00 |
| Tail Tags Cattle | Each | $0.20 |
| Stethoscope | Each | $45.00 |
| TB Ear tag Applicators | Each | $54.00 |
| Thermometer | each | $4.60 |
| Trocar & Cranula | Set | $10.50 |
| | | |
| ***MISCELLANEOUS ITEMS*** | | |
| Copper Sulphate | 1kg | $21.00 |
| Copper Sulphate | 2kg | $45.00 |
| Dermacleans | 500ml | $72.00 |
| Oticlean Trigger | 500ml | $14.70 |
| Dermolyse Solution | 500ml | $10.60 |
| Difil lysing Solution 2.5ltrs | Each | $43.40 |
| Fly Strike Powder | 500g | $60.00 |
| Glycerine | 2ltr | $17.50 |
| Glycerine | 1ltr | $23.00 |
| Witness Firofilaria test kits | 10's | $140.00 |
| Stockholm tar | 1ltr | $42.00 |
| Water for injection | 100ml | $3.10 |
| Obstetric lubricant | 5ltrs | $27.50 |
| Otoderm solution | 100mls | $11.40 |
| Ovarid Tabs 5mg | 200's | $82.90 |
| Calci Pup Powder | 600g | $10.00 |
| Multi Stix 10sq | Pkt | $50.25 |
| Pro Heart Injection SR [Small] 10ml | Pkt | $662.00 |
| Snap Heart Worm Antigens 56/9s | Pkt | $64.00 |
| Oestradiol Benzoate S/A | 5mls | $11.50 |
| Oticlean Nozzle | 125mls | $8.90 |
| Castrator Triple Crush [Emusculator] | each | $461.00 |
| Agen Canine Heart Worm Test | 10's | $254.00 |
| Amillyn 100mg Tabs | 100's tabs | $5.00 |
| Antisedan | 10mls | $94.40 |
| Apomorhine Tabs | 20 tabs | $122.00 |
| Baytril Injection 5% | 50mls | $88.20 |
| Canaural Eardrops | 15mls | $14.60 |
| Depo Medral 20mg/ml | 20mls | $60.00 |
| Domitor | 10mls | $104.90 |
| Frusemide 50mg | 50mls | $15.10 |
| Keto Profen Injection | 50mls | $24.40 |
| Metacam Oral Drops | 10mls | $16.50 |
| Metomide Injection | 20mls | $10.00 |
| Metomide Oral Tabs | 500tabs | $77.70 |
| Neocort 50g | tube | $7.00 |
| Niramine Injection | 50mls | $14.00 |
| Oticlean Nozzle | 125mls | $8.90 |
| Otamax Ointment | 14mls | $46.00 |
| Panalog Ointment | 15mls | $40.00 |
| Pentothal [thiaobarb] | 5g | $53.00 |
| Rimadyl 20mg Tabs | 100tabs | $53.70 |
| Rimadyl chewable 25mg | 60's | $48.20 |
| Promex 10mg tabs | 150 tabs | $25.50 |
| Surolan | 15mls | $14.75 |
| Torbugesic | 10mls | $101.70 |

| | | |
|---|---|---|
| Ivomec Oral Drench | 20ltrs | 840.00 |
| Metacam Injection | 10mls | $41.85 |
| Pamlin Injection | 20mls | $25.70 |
| Flusapex Tablets | 100 tabs | $8.50 |
| Nizoral 200mg [ketoconazole] | 30 tabs | $62.45 |
| Multikbex Injection (Vitamin ADE) | 100mls | $60.00 |
| Amoxyclav Tabs 200mg 200's | 200 tabs | $128.95 |
| Direa Tabs 1000mg | 50's | $17.30 |
| Zoletil 50 | g | $22.25 |
| Agen Parvo Test Kit | 5's | $156.10 |
| Propalin Syrup | 100mls | $49.90 |
| Rimadyl 100mg tabs | 14's | $35.10 |
| | | |

*(Quoted from the AH&P Drug Price Lists)*

### 7.3.2 FMIB SLAUGHTER CHARGES

| *Class* | *VEP ($)* | *VIP ($)* |
|---|---|---|
| Cattle | 0.38/kg | 0.437/kg |
| Pig | 0.50/kg | 0.644/kg |
| Goat | 2.50/kg | 2.875/kg |
| Sheep | 5.00/kg | 5.75/kg |

## 7.4 STOCK & POULTRY FEED

### 7.4.1 *Goodman Fielder International - Crest Products*

| Product | Packing Per Carton | New VEP Price | New VIP Price |
|---|---|---|---|
| **Chicken** | | | |
| Feed Chick Grower Pellet 25kg | 25kg Bag | $31.01 | $35.66 |
| Feed Chick Layer Pellets 25kg | 25kg Bag | $34.78 | $40.00 |
| Layer Crumble 25kg | 25kg Bag | $35.99 | $41.39 |
| Feed Western Starter Cr25kg | 25kg Bag | $27.47 | $31.59 |
| Feed West. Grower Pellet 25kg | 25kg Bag | $32.30 | $25.64 |
| Broiler Finisher (1) – 25kg | 25kg Bag | $42.75 | $49.16 |
| Feed Broiler Grower Pellets | 25kg Bag | $14.72 | $16.93 |
| Pullet Grower Crumble 25kg | 25kg Bag | $31.01 | $35.66 |
| Feed Broiler Grower Pellets 25kg | 25kg Bag | $39.66 | $45.60 |
| Feed Broiler Starter Crumble 10kg | 25kg Bag | $14.98 | $17.23 |
| Feed Broiler Starter Crumble 25kg | 25kg Bag | $39.91 | $45.89 |
| Feed Chick Starter Crumble 25kg | 25kg Bag | $35.78 | $41.15 |
| **Duck** | | | |
| Feed Duck Breeder 25kg | 25kg Bag | $35.12 | $40.39 |
| Feed Duck Grower 25kg | 25kg Bag | $35.05 | $40.30 |
| Feed Dairy Pellet 15% 25kg | 25kg Bag | $25.03 | $28.78 |

| | | | |
|---|---|---|---|
| **Calf Feed** | | | |
| Calf Pellets 25kg | 25kg Bag | $31.66 | $36.41 |
| **Fish** | | | |
| Feed Tilapia Grower Mash 25kg | 25kg Bag | $35.64 | $40.99 |
| Feed Tilapia Grower Pellet 25kg | 25kg Bag | $31.57 | $36.31 |
| **Pig & Horse Feed** | | | |
| Horse Pellet Feed 25kg | 25kg Bag | $23.68 | $27.24 |
| Feed Pig Grower 25kg | 25kg Bag | $26.64 | $30.64 |
| Feed Pig Breeder 25kg | 25kg Bag | $25.71 | $29.56 |
| Feed Pig Weaner 25kg | 25kg Bag | $33.74 | $38.80 |

*(Price list of Crest - Goodman Fielder International)*

### 7.4.2 *Pacific Feeds Products*

| Product | Pack | Price ($) |
|---|---|---|
| Pacific Broiler Starter | 25 kg | $37.50 |
| Pacific Broiler Grower | 25 kg | $38.00 |
| Pacific Broiler Finisher | 25 kg | $36.00 |
| | | |
| Pacific Broiler Starter | 10 kg | $17.00 |
| Pacific Broiler Grower | 10 kg | $17.50 |
| | | |
| HP Broiler Starter | 25 kg | $43.00 |
| HP Broiler Grower | 25 kg | $42.50 |
| HP Broiler Finisher | 25 kg | $41.00 |
| | | |
| Pacific Farmers Starter | 25 kg | $29.00 |
| Pacific Farmers Grower | 25 kg | $23.00 |
| | | |
| Pacific Dairy Meal | 25 kg | $26.00 |
| | | |
| Pacific Layer Chick Starter | 25 kg | $33.00 |
| Pacific Grower Crumble | 25 kg | $28.00 |
| Pacific Layer Mesh | 25 kg | $29.00 |
| | | |
| Pacific Pig Weaner | 25 kg | $33.00 |
| Pacific Pig Grower | 25 kg | $28.00 |
| Pacific Pig Breeder | 25 kg | $29.00 |
| | | |
| Pacific Prawn Pellet | 25 kg | $41.50 |
| Pacific Tilapia Pellet | 25 kg | $30.90 |

| | | |
|---|---|---|
| Pacific Tilapia Crumble | 25 kg | $28.90 |
| Pacific Quail Feed | 25 kg | $51.90 |
| | | |
| Brown Layer (Day old) | | $5.25 |
| Ross Meat Bird (Day old) | | $2.10 |
| Cockrels | | $1.00 |
| | | |
| Feeder | Large | $13.00 |
| | Medium | $9.00 |
| | | |
| Drinker | Large | $13.00 |
| | Medium | $9.00 |
| | | |

*(Quoted from Pacific Feeds Price Lists)*

## 7.5 FERTILIZERS & WEEDICIDES

### 7.5.1 *SOUTH PACIFIC FERTILIZER LIMITED PRICE LIST w.e.f 11/04/2014*

| *NPK Blends* | Bag Weight (kg) | Price - VIP ($) |
|---|---|---|
| Blend A (10:46:0) | 50 kg | 60.00 |
| Blend B (16:0:15) | 50 kg | 60.00 |
| Blend C (16:6:13) | 50 kg | 60.00 |
| 13:13:21 | 50 kg | 75.00 |
| 20:5:8 | 50 kg | 72.71 |
| 16:16:16 | 50 kg | 71.05 |
| 10:20:10 | 50 kg | 57.49 |
| 14:14:14 | 20 kg | 31.17 |
| 16:20:00 | 20 kg | 29.25 |
| ***Straight Fertilizer*** | | |
| Agricultural Lime | 50 kg | 27.36 |
| Ammonium Sulphate | 50 kg | 69.99 |
| Ammonium Molybdate | 1kg | 68.08 |
| Borax Pentahydrate | 25 kg | 102.73 |
| Calcium Nitrate | 25 kg | 43.44 |
| Copper Sulphate 5H20 | 25 kg | 187.87 |
| Di - Ammonium Sulphate | 50 kg | 104.00 |
| Dolomite | 25 kg | 15.06 |
| Ferrous Sulphate 6H20 | 25 kg | 19.57 |
| Iron Chelate | 25 kg | 307.05 |
| Magnesium Nitrate | 25 kg | 52.88 |
| Magnesium Sulphate | 50 kg | 43.70 |
| Magnesium Sulphate | 25 kg | 21.85 |
| Mono - Ammonium Phosphate (Tech Grade) | 25 kg | 51.75 |

| | | |
|---|---|---|
| Mono Potassium Phosphate | 25 kg | 64.81 |
| Muriate of Potash | 50 kg | 83.47 |
| Potassium Hydroxide | 25 kg | 76.58 |
| Potassium Nitrate | 25 kg | 85.11 |
| Single Super Phosphate | 50 kg | 41.69 |
| Sodium Molybdate | 1kg | 31.38 |
| Sulphate of Potash | 50 kg | 96.24 |
| Super Nitro Potash | 50 kg | 70.74 |
| Triple Super Phosphate | 50 kg | 62.47 |
| Urea | 50 kg | 62.00 |
| Zinc Sulphate 7H2O | 25 kg | 50.37 |
| | | |
| ***Weedicides*** | | |
| Diuron 80 WDG | 1 kg | 22.38 |
| Glyphosate 360 | 5 litres | 41.23 |
| 2,4 – D Amine 720 | 5 litres | 43.90 |
| Valpar King | 1 kg | 35.37 |
| ***Source : South Pacific Fertilizer Limited*** | | |

### 7.5.2 *AGCHEM LIMITED PRICE LIST w.e.f 08/05/2014*

| *Product* | *Quantity* | *Price ($)* |
|---|---|---|
| ***CHEMICAL FERTILIZER*** | | |
| NPK 13:13:21 | 2 kg | 6.79 |
| | 25 kg | 51.88 |
| Single Superphosphate | 25 kg | 28.77 |
| Triple Superphosphate | 25 kg | 57.73 |
| NPK 0:32:16 | 40 kg | 95.47 |
| Urea 46% | 40 kg | 76.04 |
| Muriate of Potash | 40 kg | 86.21 |
| ***LIME*** | | |
| Agricultural Lime | 2 kg | 3.15 |
| | 25 kg | 17.52 |
| Hydrated Lime | 20 kg | 21.02 |
| ***ALROC MINERAL FERTILIZER*** | | |
| | 2 kg | 5.54 |
| Alroc # 3 Mix | 25 kg | 43.63 |
| | 2 kg | 6.01 |
| Extraphos & Potash | 25 kg | 49.58 |
| | 40 kg | 81.06 |
| Phoscarb | 25 kg | 51.10 |

| | | |
|---|---|---|
| | 2 kg | 6.09 |
| Extraphos | 25 kg | 45.36 |
| Active 8 | 1 ltr | 14.31 |
| Borax | 2kg | 17.71 |
| | 25 kg | 192.38 |
| ***SUPABLENDS*** | | |
| NPK Supablend | 25 kg | 64.23 |
| D.A.P Supablend | 40 kg | 83.70 |
| Single Supablend | 40 kg | 81.53 |
| | 2 kg | 7.43 |
| Teitei Blend | 25 kg | 60.52 |
| Alroc NP 1050 | 40 kg | 89.41 |
| Alroc Grain | 40 kg | 107.31 |
| | 2 kg | 9.15 |
| Alroc Horti | 40 kg | 135.88 |
| | 2 kg | 8.45 |
| Black Urea | 25 kg | 75.10 |
| ***ENVIRON BLENDS*** | | |
| C.B.M - *Chicken Manure, blood & bone & minerals. This 100% organic blend provides the full spectrum of macro & micro elements.* | 40 kg | 73.34 |
| | 25 kg | 75.10 |
| ***FEEDSAFE ANIMAL FEEDS*** | | |
| Loose Licks - *A dry feed supplement, formulated to extract the maximum performance from dried off pasture, stubble and fodder trees.* | 2 kg | 6.94 |
| | 25 kg | 57.93 |
| Beef Up - *Organic Colloidal Minerals blended with Molasses, Copra Meal & Essential Ingredients.* | 2 kg | 6.94 |
| | 25 kg | 56.07 |
| Lucerne Pellet - *A high palatable pelletised lucerne pellet. Ideal as a supplement to grazing for any large herbivorous animals such as horses, cattle & sheep.* | 25 kg | 74.35 |
| ***WEEDICIDES*** | | |
| | 1 ltr | 19.17 |
| Agazone | 4 ltr | 58.77 |
| | 20 ltr | 265.73 |
| Escort | 40 grams | 32.97 |
| Weedmaster Duo *(360g/l Glyphosate present as the iso-propylamine salt & mono - ammonium salts)* | 20 ltr | 216.06 |
| | 1 litre | 10.69 |
| Glyphosate 360 *(360g/l Glyphosate present as the isopro-pylamine salt)* | 5 ltr | 51.82 |
| | 20 ltr | 201.31 |
| Diuron DF *(80% W/W Diuron)* | 1kg | 34.68 |
| | 2 kg | 66.94 |
| Diuron 900 DF *(900g/kg Diuron)* | | |

| | | |
|---|---|---|
| Karmex DF *(80% W/W Diuron)* | 11.34kg | 334.41 |
| Krovar IDF *(400g/kg Diuron & 400g/kg Bromail)* | 2.5kg | 382.79 |
| Comet 400 *(400g/l Fluroxypyr present as the methylheptyl ester)* | 10 ltr | 660.37 |
| | 1 ltr | 21.06 |
| MCPA (27.4% w/v MCPA) | 4 ltr | 60.44 |
| | 20 ltr | 277.11 |
| | 1 ltr | 19.97 |
| Canespray | 4 ltr | 68.97 |
| | 20 ltr | 322.98 |
| | 1 ltr | 17.03 |
| Amine 2.4-D *(720g/l 2.4 D Acid)* | 4 ltr | 57.15 |
| | 20 ltr | 264.17 |
| | 1 ltr | 30.52 |
| Propal *(360g/l Propanil)* | 4 ltr | 103.99 |
| | 20 ltr | 296.51 |
| Atrazine *(500g/l Atrazine)* | 1 ltr | 18.03 |
| | 4 ltr | 59.72 |
| Velpar K4 *(131g/kg Hexazinone) (470g/kg Diuron)* | 1 kg | 39.98 |
| | 50kg | 1,835.28 |
| | 1 ltr | 18.98 |
| Weedkiller E40 *(2.4D Ester, 40% W/V a.e 24 Dichlorophenoxy Ester)* | 4 ltr | 60.75 |
| | 20 ltr | 282.21 |
| Tzar *(99.5g/l Quizalofop-p-ethyl)* | 1 ltr | 32.74 |
| ***FUNGICIDES*** | | |
| Kocide *(350g/kg Copper as Copper Hydroxide)* | 500 g | 35.65 |
| Dithane M45- *Mancozeb (80% WW Mancozeb)* | 1kg | 22.33 |
| Manzate *(750g/kg Mancozeb)* | 1 kg | 23.94 |
| | 10 kg | 204.26 |
| Punch *(40% W/V Flusilazol)* | 250 ml | 64.31 |
| Sundomil *(Active constituents : 640g/kg Mancozeb, 80g/kg Metalaxy)* | 1/2 kg | 18.64 |
| Benomyl 50% *WP (500g/kg Benomyl)* | 100 g | 5.68 |
| ***INSECTICIDES*** | | |
| Suncis 25 EC *(2.5% Deltamethrin)* | 500 ml | 15.83 |
| Sundothrin *(Permethrin 25% EC)* | 1 ltr | 36.20 |
| Chlorpyrifos 500 EC *(500g/l Chlorpyrifos)* | 1 ltr | 37.60 |
| Steward 150 SC *(150g/l Indoxacarb)* | 1 ltr | 333.49 |
| Malathion 50 EC *(500g/l W/V Maldison)* | 1 ltr | 22.17 |
| Diazinon 20% (20% W/V Diazinon) | 1 ltr | 21.70 |
| Rogor *(30% W/V Dimethioate)* | 1 ltr | 32.77 |
| Suncloprid 20SL *(Imidacloprid 20SL)* | 1 ltr | 32.88 |
| Sunthene *(Acephate 75 SP)* | 100 g | 5.04 |
| Bifenthrin *(Bifenthrin 80g/l (8%) %W/V* | 1 ltr | 29.61 |
| Prevathon *(Contains 5% w/w (51.5g/l) chlorantraniliprole in the form of a suspension concentrate).* | 100ml | 38.19 |
| Diazinon 80% *(80% W/V Diazinon)* | 1 ltr | 37.58 |
| Diazinon 20% *(20% W/V Diazinon)* | 1 ltr | 21.70 |

| | | |
|---|---|---|
| ***LIQUID FERTILIZERS BIOLIFE BIOLOGICALS*** | | |
| Bio Fertilizer Soil *(Designed to enhance & promote biological diversity in the soil. Bio-fertilizer soil inoculates the soil with beneficial fungi & bacteria to assist plant establishment)* | 1 ltr | 14.31 |
| | 4 ltrs | 42.93 |
| | 20 ltrs | 190.93 |
| | 1000 ltrs | 8,369.25 |
| Bio Fertilizer Growth *(Enhances plant response to foliar fertilizers. Growth is a foliar applied biological inoculant uniquely brewed in Calcium & Organic nitrogen with Phosphate and minor elements. It is designed to maximize vegetative plant growth stage).* | 1 ltr | 14.31 |
| | 4 ltrs | 42.93 |
| | 20 ltrs | 190.93 |
| | 1000 ltrs | 8,369.25 |
| Bio Fertilizer Harvest *(A biological inoculant designed to maximize flower bloom, flower retention and harvest yield. Combined with the appropriate liquid fertilizer, harvest will maximize yield).* | 1 ltr | 14.31 |
| | 4 ltrs | 42.93 |
| | 20 ltrs | 190.93 |
| | 1000 ltrs | 8,369.25 |
| Bio Fertilizer Digester *(Ideal for stubble breakdown. Residue digester will enhance the conversion of organic matter into active humus by inoculating & stimulating beneficial soil biology.* | 1 ltr | 14.31 |
| | 4 ltrs | 42.93 |
| | 20 ltrs | 190.93 |
| | 1000 ltrs | 8,369.25 |
| ***GENERAL PRODUCTS*** | | |
| Folifert *(Plant Hormone Fertilizer)* | 1kg | 15.55 |
| Pineapple Spray *(480g/l Ethephon)* | 1 ltr | 25.50 |
| Growth Formula *(2.25g/l Vitamin B1; 0.075g/l Indolectic Acid; 0.07g/l Napthalene Acetic Acid)* | 1 ltr | 7.98 |
| X - 77 Sticker | 1 ltr | 13.97 |
| | 4 ltrs | 46.24 |
| | 20 ltrs | 217.57 |
| Input (Penetrant) | 250mls | 21.57 |
| | 5 ltr | 264.77 |
| Bluespot Dye (High performance basic dye) | 1 ltr | 66.38 |

## *7.5.3 PRICE LIST FOR KISHORE INVESTMENT - LEVUKA*

| *Product* | *Quantity* | *Price ($)* |
|---|---|---|
| Paraquat | 1 ltr | 10.95 |
| Agazone | 1 ltr | 15.50 |
| Glyphosate | 1 ltr | 12.95 |
| Suncloprid | 1 ltr | 38.00 |
| Bio Soil | 1 ltr | 17.00 |
| Bio Grow | 1 ltr | 17.00 |
| Bio Harvest | 1 ltr | 17.00 |
| Urea | 1 kg | 2.50 |
| NPK | 1 kg | 3.00 |

| | | |
|---|---|---|
| Teitei Blend | 1 kg | 3.50 |

*(Source : Kishore Investment - Levuka 13.6.2014)*

## 7 .6 ROADS

The Government has introduced a revised road user levy charged according to Gross Vehicle Weight for vehicle weighing 3500kg or more with effect from 1st January 2011. Below is the Fee Structure Table

| Gross Vehicle Weight (Laden Mass) | Old Levy per ('000) kg | Old Levy per Vehicle | New Levy per ('000) kg (18/6/09) | New Levy per Vehicle (18/06/09) | VEP of New Levy per Vehicle as at 18/06/09 | VIP of 15% as at 01/01/2011 |
|---|---|---|---|---|---|---|
| 3500kg - 3999kg | $75 | $225 | $56.25 | $168.25 | $150 | $172.50 |
| 4000kg - 4999kg | $75 | $300 | $56.25 | $225.00 | $200 | $230.00 |
| 5000kg - 5999kg | $75 | $375 | $56.25 | $281.25 | $250 | $287.50 |
| 6000kg - 6999kg | $75 | $450 | $56.25 | $337.50 | $300 | $345.00 |
| 7000kg - 7999kg | $75 | $525 | $56.25 | $393.75 | $350 | $402.50 |
| 8000kg - 8999kg | $75 | $600 | $56.25 | $450.00 | $400 | $460.00 |
| 9000kg - 9999kg | $75 | $675 | $56.25 | $506.25 | $450 | $517.50 |
| 10,000kg - 10,999kg | $75 | $750 | $56.25 | $562.50 | $500 | $575.00 |
| 11,000kg - 11,999 kg | $75 | $825 | $56.25 | $618.75 | $550 | $632.50 |
| 12,000kg - 12,999kg | $75 | $900 | $56.25 | $675.00 | $600 | $690.00 |
| 13,000kg - 13,999kg | $75 | $975 | $56.25 | $731.25 | $650 | $747.50 |
| 14,000kg- 14,999kg | $75 | $1,050 | $56.25 | $787.50 | $700 | $805.00 |
| 15,000kg - 15,999kg | $75 | $1,125 | $56.25 | $843.75 | $750 | $862.50 |
| 16,000kg - 16,999kg | $75 | $1,200 | $56.25 | $900.00 | $800 | $920.00 |
| 17,000kg - 17,999kg | $75 | $1,275 | $56.25 | $956.25 | $850 | $977.50 |
| 18,000kg - 18,999kg | $75 | $1,350 | $56.25 | $1,012.50 | $900 | $1,035.00 |
| 19,000kg - 19,999kg | $75 | $1,425 | $56.25 | $1,068.75 | $950 | $1,092.50 |
| 20,000kg - 20,999kg | $75 | $1,500 | $56.25 | $1,125.00 | $1,000 | $1,150.00 |
| 21,000kg - 21, 999kg | $75 | $1,575 | $56.25 | $1,181.25 | $1,050 | $1,207.50 |
| 22,000kg - 22,999kg | $75 | $1,650 | $56.25 | $1,237.50 | $1,100 | $1,265.00 |
| 23,000kg - 23,999kg | $75 | $1,725 | $56.25 | $1,293.75 | $1,150 | $1,322.50 |
| 24,000kg - 24,999kg | $75 | $1,800 | $56.25 | $1,350.00 | $1,200 | $1,380.00 |
| 25,000kg - 25,999kg | $75 | $1,875 | $56.25 | $1,406.25 | $1,250 | $1,437.50 |
| 26,000kg - 26,999kg | $75 | $1,950 | $56.25 | $1,462.50 | $1,300 | $1,495.00 |
| 27,000kg - 27,999kg | $75 | $2,025 | $56.25 | $1,518.75 | $1,350 | $1,552.50 |
| 28,000kg - 28,999kg | $75 | $2,100 | $56.25 | $1,575.00 | $1,400 | $1,610.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 29,000kg - 29,999kg | $75 | $2,175 | $56.25 | $1,631.25 | $1,450 | $1,667.50 |
| 30,000kg - 30,999kg | $75 | $2,250 | $56.25 | $1,687.50 | $1,500 | $1,725.00 |
| 31,000kg - 31,999kg | $75 | $2,325 | $56.25 | $1,743.75 | $1,550 | $1,782.50 |
| 32,000kg - 32,999kg | $75 | $2,400 | $56.25 | $1,800.00 | $1,600 | $1,840.00 |
| 33,000kg - 33,999kg | $75 | $2,475 | $56.25 | $1,856.25 | $1,650 | $1,897.50 |
| 34,000kg - 34,999kg | $75 | $2,550 | $56.25 | $1,912.50 | $1,700 | $1,955.00 |
| 35,000kg - 35,999kg | $75 | $2,625 | $56.25 | $1,968.75 | $1,750 | $2,012.50 |
| 36,000kg - 36,999kg | $75 | $2,700 | $56.25 | $2,025.00 | $1,800 | $2,070.00 |
| 37,000kg - 37,999kg | $75 | $2,775 | $56.25 | $2,081.25 | $1,850 | $2,127.50 |
| 38,000kg - 38,999kg | $75 | $2,850 | $56.25 | $2,137.50 | $1,900 | $2,185.00 |
| 39,000kg - 39,999kg | $75 | $2,925 | $56.25 | $2,193.75 | $1,950 | $2,242.50 |
| 40,000kg - 40,999kg | $75 | $3,000 | $56.25 | $2,250.00 | $2,000 | $2,300.00 |
| 41,000kg - 41,999kg | $75 | $3,075 | $56.25 | $2,306.25 | $2,050 | $2,357.50 |
| 42,000kg - 42,999kg | $75 | $3,150 | $56.25 | $2,362.50 | $2,100 | $2,415.00 |
| 43,000kg - 43,999kg | $75 | $3,225 | $56.25 | $2,418.75 | $2,150 | $2,472.50 |
| 44,000kg - 44,999kg | $75 | $3,300 | $56.25 | $2,475.00 | $2,200 | $2,530.00 |
| 45,000kg - 45,999kg | $75 | $3,375 | $56.25 | $2,531.25 | $2,250 | $2,587.50 |
| 46,000kg - 46,999kg | $75 | $3,450 | $56.25 | $2,587.50 | $2,300 | $2,645.00 |
| 47,000kg - 47,999kg | $75 | $3,525 | $56.25 | $2,643.75 | $2,350 | $2,702.50 |
| 48,000kg - 48,999kg | $75 | $3,600 | $56.25 | $2,700.00 | $2,400 | $2,760.00 |
| 49,000kg - 49,999kg | $75 | $3,675 | $56.25 | $2,756.25 | $2,450 | $2,817.50 |
| 50,000kg - 50,999kg | $75 | $3,750 | $56.25 | $2,812.50 | $2,500 | $2,875.00 |
| 51,000kg - 51,999kg | $75 | $3,825 | $56.25 | $2,868.75 | $2,550 | $2,932.50 |
| 52,000kg - 52,999kg | $75 | $3,900 | $56.25 | $2,925.00 | $2,600 | $2,990.00 |
| 53,000kg - 53,999kg | $75 | $3,975 | $56.25 | $2,981.25 | $2,650 | $3,047.50 |
| 54,000kg - 54,999kg | $75 | $4,050 | $56.25 | $3,037.50 | $2,700 | $3,105.00 |
| 55,000kg - 55,999kg | $75 | $4,125 | $56.25 | $3,093.75 | $2,750 | $3,162.50 |
| 56,000kg - 56,999kg | $75 | $4,200 | $56.25 | $3,150.00 | $2,800 | $3,220.00 |
| 57,000kg - 57,999kg | $75 | $4,275 | $56.25 | $3,206.25 | $2,850 | $3,277.50 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 58,000kg - 58,999kg | $75 | $4,350 | $56.25 | $3,262.50 | $2,900 | $3,335.00 |
| 59,000kg - 59,999kg | $75 | $4,425 | $56.25 | $3,318.75 | $2,950 | $3,392.50 |
| 60,000kg - 60,999kg | $75 | $4,500 | $56.25 | $3,375.00 | $3,000 | $3,450.00 |

## 7.7 CROPPING EXPENSES

### 7.7.1 Vegetable Seeds

| Description | Quantity | Price ($) |
|---|---|---|
| Capsicum | 1 x 20g | 5.50 |
| Carrot Bonanza variety | 1 x 20g | 8.50 |
| Carrot Manchester variety | 1 x 20g | 2.80 |
| Carrot New Kuroda | 1 x 20g | 5.00 |
| Chinese Cabbage | 1 x 30g | 1.50 |
| Chinese Cabbage | 1 tin | 21.50 |
| Cucumber Genuine | 1 x 50g tin | 38.90 |
| Cucumber Hybrid - Bountiful | 1 x 10g | 8.80 |
| Eggplant - Fond may variety | 1 x 10g | 8.50 |
| English Cabbage | 1 x 20g | 26.50 |
| French Bean | 1kg | 9.60 |
| Lettuce | 1 x 20g | 7.50 |
| Long Bean - Darkgreen | 1kg | 28.50 |
| Okra | 1 x 400g | 19.00 |
| Okra Hybrid | 1 x 50g tin | 16.90 |
| Pumpkin | 1 x 10g | 12.50 |
| Radish | 1kg | 21.50 |
| Tomato Hybrid - Raising Sun | 1 x 10g | 17.60 |
| | | |

Farmers need to have access to good seeds in order to produce quality crops and produce in Fiji. Vegetable seeds like tomatoes, eggplant, capsicum together with maize are available at the Sigatoka Research Station in which orders can be placed through your Locality Field Officer. On the same note, Commercial firms like Hop Tiy Limited is also selling seed as per detail outline.

### 7.7.2 Planting Materials

Dalo
- Tausala - $20/100 suckers
- Hybrid - $10/100 suckers
- Jabeni - $35/100 suckers

Cassava - $0.10/cutting

Kumala - $0.05/cutting

Pineapple - $20/100 suckers

## 7.8 FARMING TOOLS AND EQUIPMENTS

| Tools & Equipments | Suva Price ($) | Nausori Price ($) | Levuka Price ($) |
|---|---|---|---|
| Digging Fork S&J | $95.00 | $72.00 | 115.00 |
| Digging Spade S&J | $62.50 | $63.00 | 85.00 |

| | | | |
|---|---|---|---|
| Post Hole Spade S&J | $79.90 | $67.00 | 85.00 |
| Long Handle Shovel | $17.90 | $11.00 | 30.00 |
| Garden Rake 14 Teeth | $5.50 | $15.00 | $25.00 |
| Crow Bar 1800 x 25mm Hex | $89.90 | $67.60 | $89.90 |
| Knife | $22.50 | $21.00 | $20.00 |
| Knapsack Sprayer 15L | $49.90 | $35.50 | $40.00 |
| Chainsaw 16'' | - | $250.00 | - |
| Chainsaw Makita Petrol 24''-2 stroke#DCS7901/60 OPE | $2295.00 | - | - |
| Ferton Grass Trimmer | - | $290.00 | - |

Prices may vary outside Suva and Viti Levu.

## 7.9 FUEL PRICES

| Fuel | Suva Price ($) | Levuka Price ($) | Savusavu Price ($) |
|---|---|---|---|
| Diesel | $2.31/L | $2.37/L | $2.34/L |
| Super | $2.60/L | $2.68/L | $2.62/L |
| Premix | $2.53/L | $2.66/L | $2.66/L |
| Kerosene | $1.82/L | $1.96/L | $1.88/L |
| Engine Oil | $12.05/L | $10/L | $8/L |
| Auto Transmission Oil | $15.75/L | $11/L | $12/L |
| Breakfluids | $10/L | $18/L | $14/L |
| Gear Oil | $20.35/L | $10/L | $6/L |

## 7.10 BUILDING MATERIALS & CULVERTS a)

| Product | Quantity | Price ($) |
|---|---|---|
| River Gravel x 4 Cubic Meter Load | 1 Load | $270.00 |
| Fine Sand x 4 Cubic Meter load | 1 Load | $270.00 |
| Round Mild Steel 5mm x 5.5mtr | 1 Length | $2.30 |
| Deformed Bars GR300 12mm x 6m (188 LTH/TON) | 1 Length | $12.02 |
| Galvanised Wire 8g (4.0mm)2kg | 1 Coil | $7.85 |
| Galvanised Wire 10g (3.15mm) 2kg | 1 Coil | $7.85 |
| NZ Pine 150x25MM Weather Board TT H3.2 1/6.000 | $M^3$ | $28.13 |
| Skycool Insulation Single Sided Fire Retardant 50 Sq Mtr #SC6160 | 1 Roll | $69.90 |
| Skycool Insulation Double Sided Fire Retardant 50 Sq Meter #SC6125 | 1 Roll | $98.00 |

| | | |
|---|---|---|
| Black Visqueen 002 1830mm x 60m | 1 Coil | $21.51 |
| PVC Sheeting 54" x 0.40mm Clear (45.72mtrs per roll) Thick | 1 Meter | $7.95 |
| Black Mesh Wire 6M x 2.4M x 665 | 1 Sheet | $93.00 |
| Galvanised Mesh 2400mm x 1200mm x 228 | 1 Sheet | $39.00 |
| Zincalume Roofing Iron 5' x 0.42 Corrugated 1.5m | 1 Sheet | $14.75 |
| Zincalume Roofing Iron 6' x 0.42 Corrugated 1.8m | 1 Sheet | $17.70 |
| Zincalume Roofing Iron 7' x 0.42 Corrugated 2.1m | 1 Sheet | $20.65 |
| Zincalume Roofing Iron 8' x 0.42 Corrugated 2.44m | 1 Sheet | $23.60 |
| Zincalume Roofing Iron 9' x 0.42 Corrugated 2.7m | 1 Sheet | $29.50 |
| Zincalume Roofing Iron 10' x 0.42 Corrugated 3.05m | 1 Sheet | $32.45 |
| Zincalume Roofing Iron 12' x 0.42 Corrugated 3.66m | 1 Sheet | $35.40 |
| Zincalume Roofing Iron 13' x 0.42 Corrugated 3.96m | 1 Sheet | $38.35 |
| Zincalume Roofing Iron 14' x 0.42 Corrugated 4.27m | 1 Sheet | $41.30 |
| Zincalume Roofing Iron 15' x 0.42 Corrugated 4.57m | 1 Sheet | $44.25 |
| Zincalume Roofing Iron 16' x 0.42 Corrugated 4.88m | 1 Sheet | $47.20 |
| Zincalume Roofing Iron 17' x 0.42 Corrugated 5.18m | 1 Sheet | $50.15 |
| Zincalume Roofing Iron 18' x 0.42 Corrugated 5.49m | 1 Sheet | $53.10 |
| Zincalume Roofing Iron 19' x 0.42 Corrugated 5.79m | 1 Sheet | $56.05 |
| Zincalume Roofing Iron 20' x 0.42 Corrugated 6.1m | 1 Sheet | $59.00 |
| Zincalume Roofing Iron 21' x 0.42 Corrugated | 1 Sheet | $63.00 |
| Zincalume Roofing Iron 22' x 0.42 Corrugated | 1 Sheet | $66.00 |
| Zincalume Roofing Iron 23' x 0.42 Corrugated | 1 Sheet | $69.00 |
| Zincalume Roofing Iron 24' x 0.42 Corrugated | 1 Sheet | $72.00 |
| Bil Nail JHG 50mm x 2.80mm (2") (Jolt Head Galvanised) R/P x 1kg | 1kg | $4.78 |
| Bil Nail JHG 75mm x 3.75mm (2") (Jolt Head Galvanised) R/P x 1kg | 1kg | $4.38 |

| | | |
|---|---|---|
| Bil Nail JHG 100mm x 4.50mm (2″) (Jolt Head Galvanised) R/P x 1kg | 1kg | $4.38 |
| Bil Nail JHG 125mm x 5.60mm (2″) (Jolt Head Galvanised) R/P x 1kg | 1kg | $5.39 |
| Bil Nail JHG 150mm x 5.60mm (2″) (Jolt Head Galvanised) R/P x 1kg | 1kg | $5.39 |

*Quoted by Vinod Patel & Co Ltd - 21/08/2014*

*Prices may vary outside Suva and Viti Levu.*

## 7.10 b CONCRETE PIPES

| Length | 1.22m | Factory | Suva | |
|---|---|---|---|---|
| **Diameter** | **300 to 800** | | **Fiji** | |
| **Diameter** | **Class (thickness)** | **VEP** | **VIP** | **WEIGHT (ton)** |
| 300 | 2 | $118.14 | $136 | 0.103 |
| | 3 | $121.10 | $139 | 0.103 |
| | 4 | $145.32 | $167 | 0.105 |
| 375 | 2 | $136.91 | $157 | 0.142 |
| | 3 | $140.34 | $161 | 0.146 |
| | 4 | $175.42 | $202 | 0.146 |
| 450 | 2 | $160.34 | $184 | 0.203 |
| | 3 | $165.95 | $191 | 0.205 |
| | 4 | $219.05 | $252 | 0.208 |
| 525 | 2 | $180.08 | $207 | 0.234 |
| | 3 | $200.39 | $230 | 0.275 |
| | 4 | $265.52 | $305 | 0.315 |
| 600 | 2 | $218.91 | $252 | 0.286 |
| | 3 | $240.45 | $277 | 0.316 |
| | 4 | $302.28 | $348 | 0.357 |
| 750 | 2 | $290.65 | $334 | 0.412 |
| | 3 | $316.46 | $364 | 0.436 |
| | 4 | $441.88 | $508 | 0.528 |
| 900 | 2 | $384.73 | $442 | 0.55 |
| | 3 | $423.69 | $487 | 0.606 |
| | 4 | $545.79 | $628 | 0.692 |

| | | | | |
|---|---|---|---|---|
| 1050 | 2 | $490.64 | $564 | 0.718 |
| | 3 | $543.64 | $625 | 0.784 |
| | 4 | $697.48 | $802 | .0925 |
| 1200 | 2 | $609.97 | $701 | 0.897 |
| | 3 | $663.33 | $763 | 0.974 |
| | 4 | $852.73 | $981 | 1.135 |
| 1500 | 2 | $822.51 | $946 | 1.215 |
| | 3 | $930.18 | $1,070 | 1.369 |
| | 4 | $1,272.48 | $1,463 | 1.639 |
| 1800 | 2 | $1,140.20 | $1,311 | 1.704 |
| | 3 | $1,283.04 | $1,475 | 1.891 |
| | 4 | $1,729.60 | $1,989 | 2.221 |

## 7.10 c CONCRETE PIPE

| | | | |
|---|---|---|---|
| **LENGTH** | 2.44 m | FACTORY | SUVA |
| **DIA** | 300 to 1800 | JOINT | FJ |

| Diameter | Class (thickness) | VEP | VIP | Weight |
|---|---|---|---|---|
| 300 | 2 | $236.28 | $272 | 0.204 tonnes |
| | 3 | $242.20 | $279 | 0.205 tonnes |
| | 4 | $290.64 | $334 | 0.208 tonnes |
| 375 | 2 | $273.82 | $315 | 0.283 tonnes |
| | 3 | $280.67 | $323 | 0.286 tonnes |
| | 4 | $350.84 | $403 | 0.291 tonnes |
| 450 | 2 | $320.68 | $369 | 0.406 tonnes |
| | 3 | $331.90 | $382 | 0.410 tonnes |
| | 4 | $438.10 | $504 | 0.416 tonnes |
| 525 | 2 | $360.15 | $414 | 0.468 tonnes |
| | 3 | $400.78 | $461 | 0.548 tonnes |
| | 4 | $531.03 | $611 | 0.628 tonnes |
| 600 | 2 | $419.27 | $482 | 0.571 tonnes |
| | 3 | $458.37 | $527 | 0.630 tonnes |
| | 4 | $604.56 | $695 | 0.712 tonnes |
| 750 | 2 | $565.41 | $650 | 0.823 tonnes |
| | 3 | $608.40 | $700 | 0.872 tonnes |
| | 4 | $883.75 | $1,016 | 1.055 tonnes |

| | | | | |
|---|---|---|---|---|
| 900 | 2 | $746.38 | $858 | 1.100 tonnes |
| | 3 | $833.16 | $958 | 1.211 tonnes |
| | 4 | $1,091.58 | $1,255 | 1.384 tonnes |
| 1050 | 2 | $953.93 | $1,097 | 1.435 tonnes |
| | 3 | $1,057.66 | $1,216 | 1.567 tonnes |
| | 4 | $1,394.95 | $1,604 | 1.848 tonnes |
| 1200 | 2 | $1,183.41 | $1,361 | 1.793 tonnes |
| | 3 | $1,320.83 | $1,519 | 1.946 tonnes |
| | 4 | $1,705.45 | $1,961 | 2.268 tonnes |
| 1500 | 2 | $1,617.37 | $1,860 | 2.430 tonnes |
| | 3 | $1,825.09 | $2,099 | 2.735 tonnes |
| | 4 | $2,544.95 | $2,927 | 3.277 tonnes |
| 1800 | 2 | $2,243.60 | $2,580 | 3.408 tonnes |
| | 3 | $2,503.66 | $2,879 | 3.780 tonnes |
| | 4 | $3,459.20 | $3,978 | 4.44 tonnes |

## 7.11a FENCING MATERIALS PRICES FROM THE COMMERCIAL UNDERTAKINGS (CUT) VATUWAQA

| Pine Posts | Feet (ft) | Price ($) |
|---|---|---|
| 1.8m x 75mm (3 inch) | 6 | $10.00 |
| 1.8m x 100mm (4 inch) | 6 | $12.00 |
| 1.8m x 125mm (5 inch) | 6 | $24.00 |
| 1.8m x 150mm (6 inch) | 6 | $26.00 |
| 2.4m x 100mm (4 inch) | 8 | $23.00 |
| 2.4m x 125mm (5 inch) | 8 | $26.00 |
| 2.4m x 150mm (6 inch) | 8 | $38.00 |
| 3m x 100mm (4 inch) | 10 | $26.00 |
| 3m x 125mm (5 inch) | 10 | $36.00 |
| 3m x 150mm (6 inch) | 10 | $51.00 |
| 3m x 200mm (8 inch) | 10 | $63.00 |
| 4m x 125mm (5 inch) | 12 | $46.00 |
| 4m x 150mm (6 inch) | 12 | $78.00 |

## 7.11b FENCING REQUIREMENT FOR 1 HA ON 3FT/4FT GOAT FENCING

1 ha = 10,000 square meters
Perimeter = ~ 100m x 4 = 400m running length

### *i)* Option 1 - Using 4 feet Fence

| Item Description | Unit | Quantity | Cost per Unit | Total Costs ($) |
|---|---|---|---|---|
| ***Posts*** | | | | |
| Type 3 Pine Post @ 5m Interval | pieces | 56 | 10 | $560 |

| | | | | |
|---|---|---|---|---|
| Type 2 (middle strainers) Pine Post @ 50m Interval | pieces | 16 | 12 | $192 |
| Type 1 Pine Post (Corner Post) at each corner | pieces | 16 | 26 | $416 |
| Rails | pieces | 8 | 12 | $96 |
| Metal Post - 3ft | pieces | 15 | 11.8 | $177 |
| ***Goat Fence*** | | | | |
| 4 ft Fence Roll | 50m roll | 8 | 150 | $1,200 |
| 18kg H/T Barbed Wire | 360m roll | 2 | 120 | $240 |
| L/T Plain Wire | 360m roll | 1 | 70 | $70 |
| | | | | |
| Staple Nails | kg | 2 | 5 | $10 |
| | | | | |
| Labour | manday | 40 | 20 | $800 |
| | | | | |
| *TOTAL* | | | | ***$3,761*** |
| ***Cost per meter*** | | | | ***$9.40*** |

**ii) Option 2 - Using 3 ft Fence**

| Item Description | Unit | Quantity | Cost per Unit | Total Costs ($) |
|---|---|---|---|---|
| ***Posts*** | | | | |
| Type 3 Pine Post @ 5m Interval | pieces | 56 | 10 | $560 |
| Type 2 (middle strainers) Pine Post @ 50m Interval | pieces | 16 | 12 | $192 |
| Type 1 Pine Post (Corner Post) at each corner | pieces | 16 | 26 | $416 |
| Rails | pieces | 8 | 12 | $96 |
| Metal Post - 3ft | pieces | 15 | 11.8 | $177 |
| ***Goat Fence*** | | | | |
| 3ft Fence Roll | 50m roll | 8 | 120 | $960 |
| 18kg H/T Barbed Wire | 360m roll | 4 | 120 | $480 |
| L/T Plain Wire | 360m roll | 1 | 70 | $70 |
| | | | | |
| Staple Nails | kg | 2 | 5 | $10 |
| | | | | |
| Labour | manday | 40 | 20 | $800 |
| | | | | |
| *TOTAL* | | | | ***$3,761*** |
| ***Cost per meter*** | | | | ***$9.40*** |

## 7.11c *FENCING REQUIREMENT FOR CATTLE*

**1 HA - 100m X 100m**

**1ha = 10,000 square meters**

**Perimeter = ~100m x 4 = 400m running length.**

(Option 1 = Use of 18kg H/T Barbed Wire - 360m)

| *Item Description* | *Unit* | *Quantity* | *Cost per Unit* | *Total Costs ($)* |
|---|---|---|---|---|
| ***Post*** | | | | |
| Type 3 Pine Post @ 5m Interval | pieces | 68 | 10 | 680 |
| Type 2 Pine Post @ 25m Interval | pieces | 16 | 12 | 192 |
| Type 1 Pine Post (Corner Post) at each corner | pieces | 16 | 26 | 416 |
| Steel Post 3ft | pieces | 15 | 11.8 | 177 |
| Rail | pieces | 8 | 12 | 96 |
| ***Barbed Wire*** | | | | |
| 18kg H/T Barbed Wire (360m) | rolls | 5 | 120 | 600 |
| Plain Wire # 8 | coil | 1 | 110 | 110 |
| Staples | kg | 2 | 5 | 10 |
| ***Labour Cost*** | manday | 40 | 20 | 800 |
| | | | | |
| **TOTAL** | | | | **$3,081.00** |
| Cost per meter | | | | $7.70 |

Assumption on Labour Costs on 100m Fencing Parameter :
(Fencing Gang = comprising of 4 able bodied men)

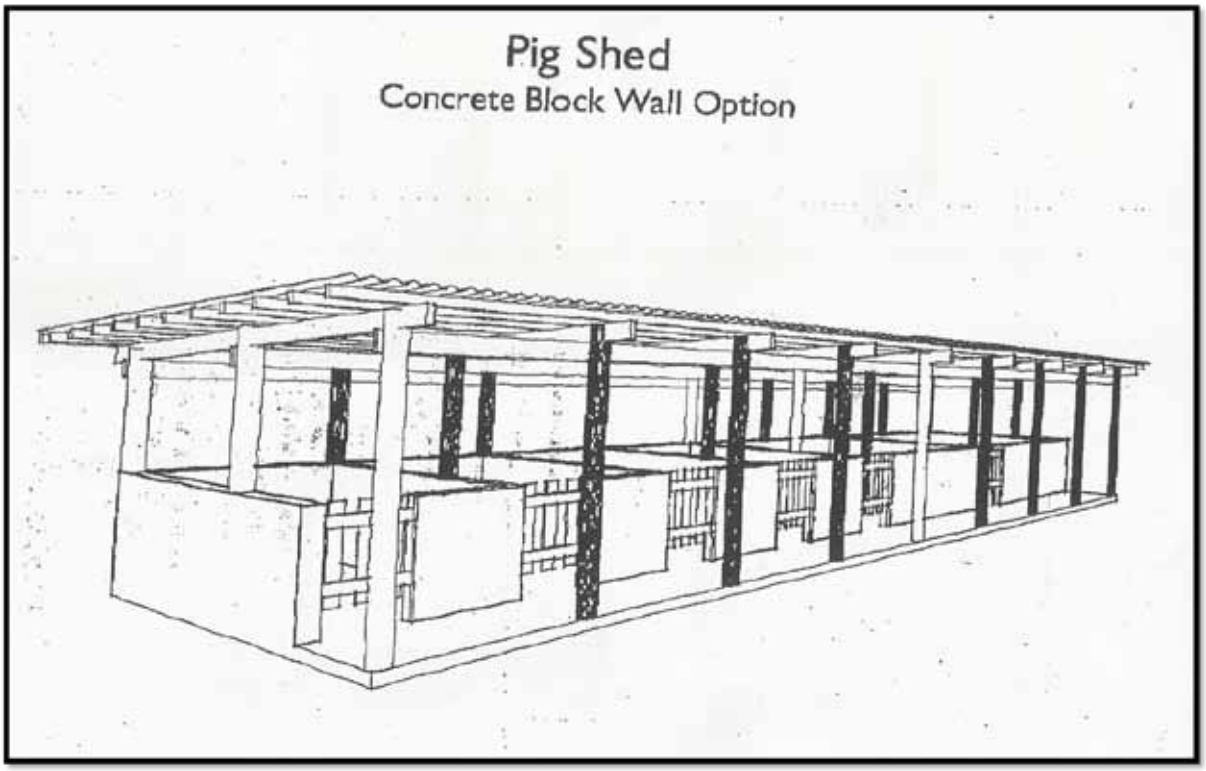
| | | |
|---|---|---|
| 25 posts per 100m @ 25 mins/post | = | 10hrs |
| Strainer - 30mins/post | = | 1hr 20 mins |
| Strainer Assembly | = | 2hrs |
| Straining of Wire | = | 6hrs |
| Manday Equivalent/100m | = | 9.6 ~ 10 mandays |

ii) (Option 2 = Use of 25kg Standard Barbed Wire (240m)

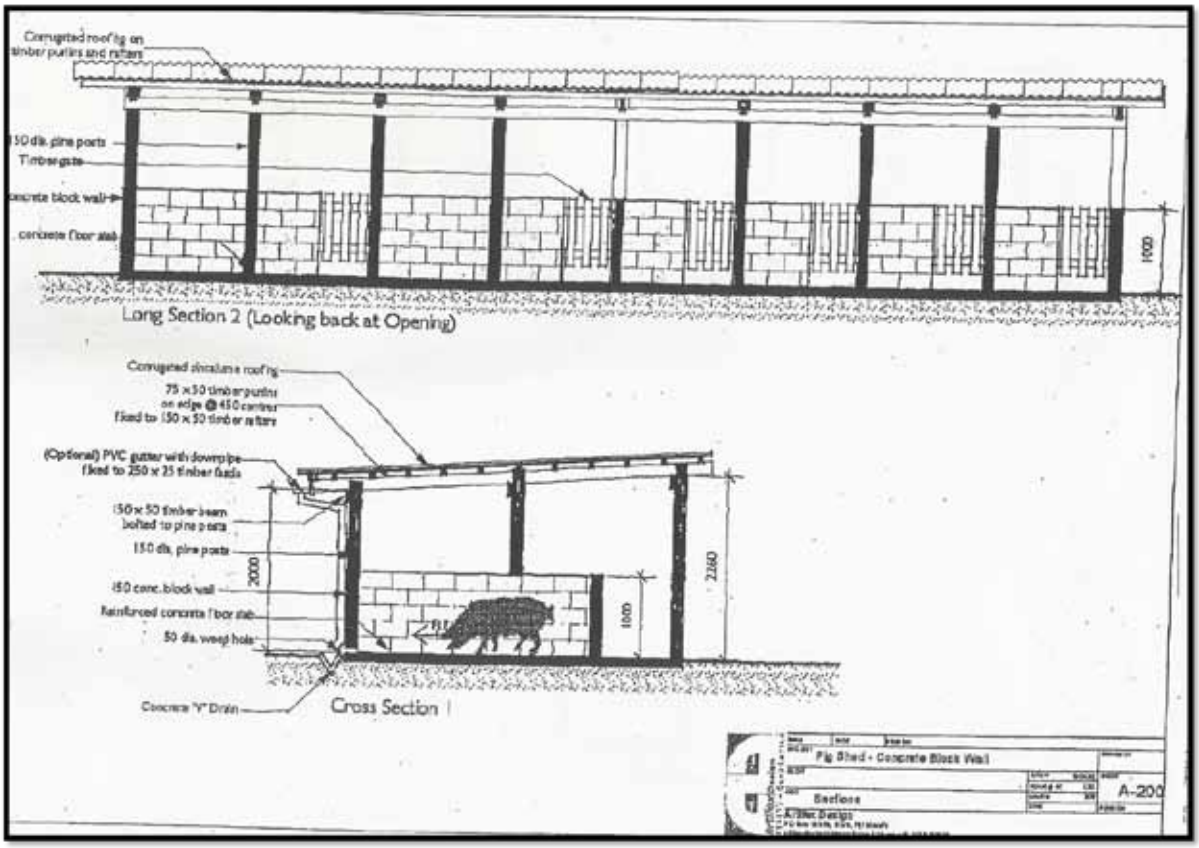
| *Item Description* | *Unit* | *Quantity* | *Cost per Unit* | *Total Costs ($)* |
|---|---|---|---|---|
| ***Post*** | | | | |
| Type 3 Pine Post @ 5m Interval | pieces | 68 | 10 | 680 |
| Type 2 Pine Post @ 25m Interval | pieces | 16 | 12 | 192 |
| Type 1 Pine Post (Corner Post) at each corner | pieces | 16 | 26 | 416 |
| Steel Post 3ft | pieces | 15 | 11.8 | 177 |
| Rail | pieces | 8 | 12 | 96 |
| ***Barbed Wire*** | | | | |
| 25kg H/T Barbed Wire (240m) | roll | 7 | 128 | 896 |
| Plain Wire # 8 | coil | 1 | 110 | 110 |
| Staples | kg | 2 | 5 | 10 |
| Labour Cost | man-days | 40 | 20 | 800 |
| | | | | |
| **TOTAL** | | | | **$2,481** |
| **Cost per meter** | | | | **$6.20** |

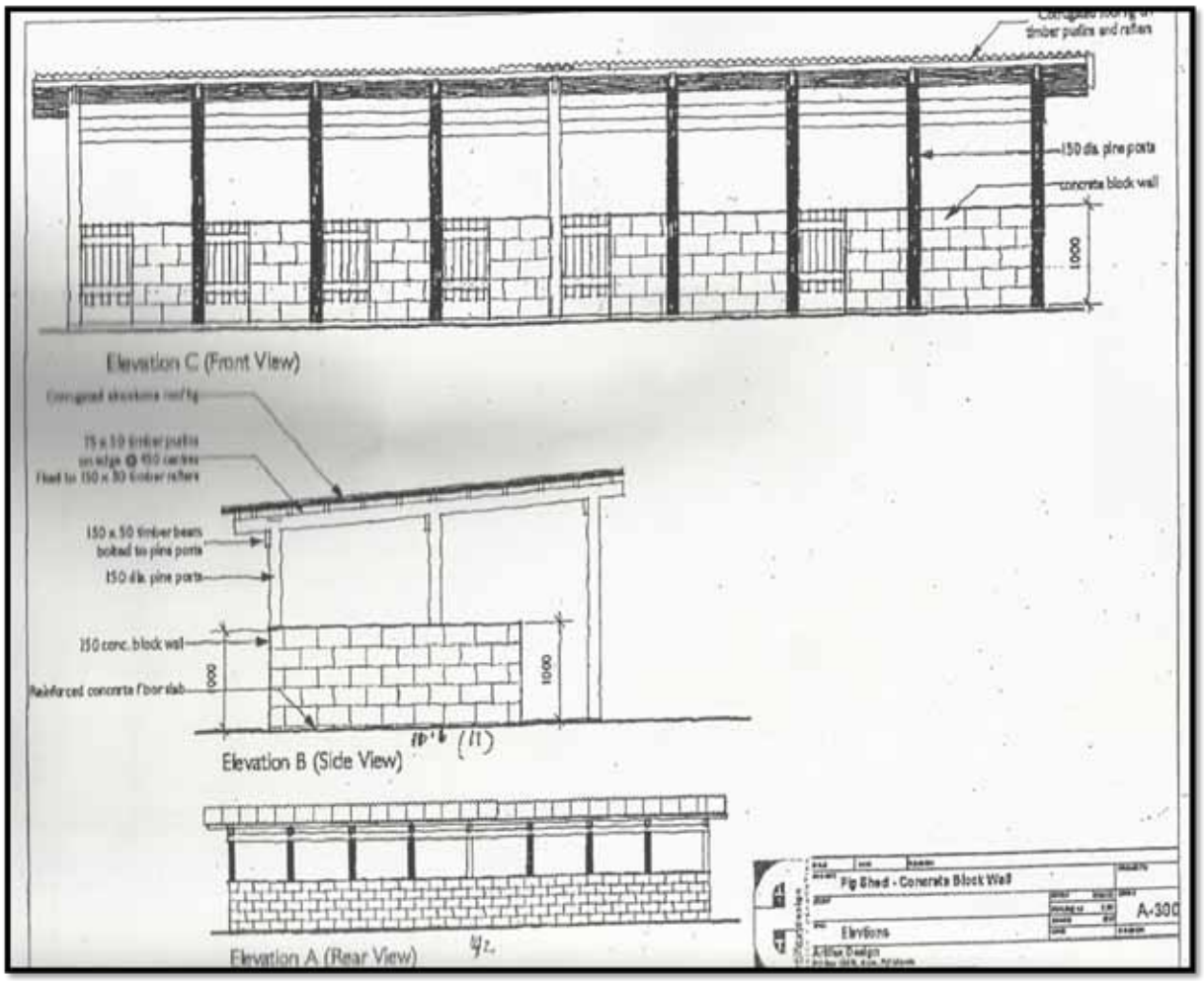
Assumption on Labour Costs on 100m Fencing Parameter :
(Fencing Gang = comprising of 4 able bodied men)

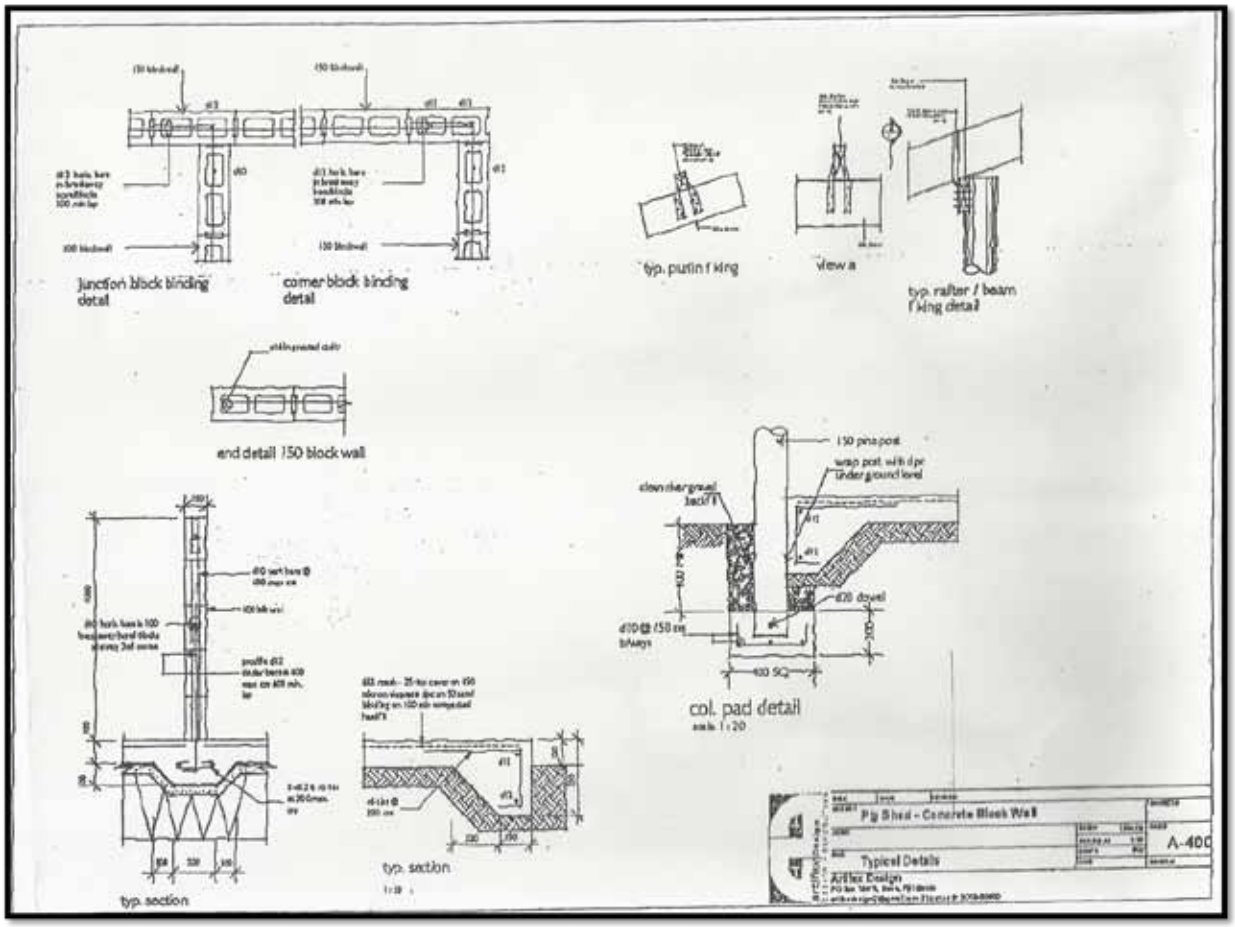
| | | |
|---|---|---|
| 25 posts per 100m @ 25 mins/post | = | 10hrs |
| Strainer - 30mins/post | = | 1hr 20 mins |
| Strainer Assembly | = | 2hrs |
| Straining of Wire | = | 6hrs |
| Manday Equivalent/100m | = | 9.6 ~ 10 mandays |

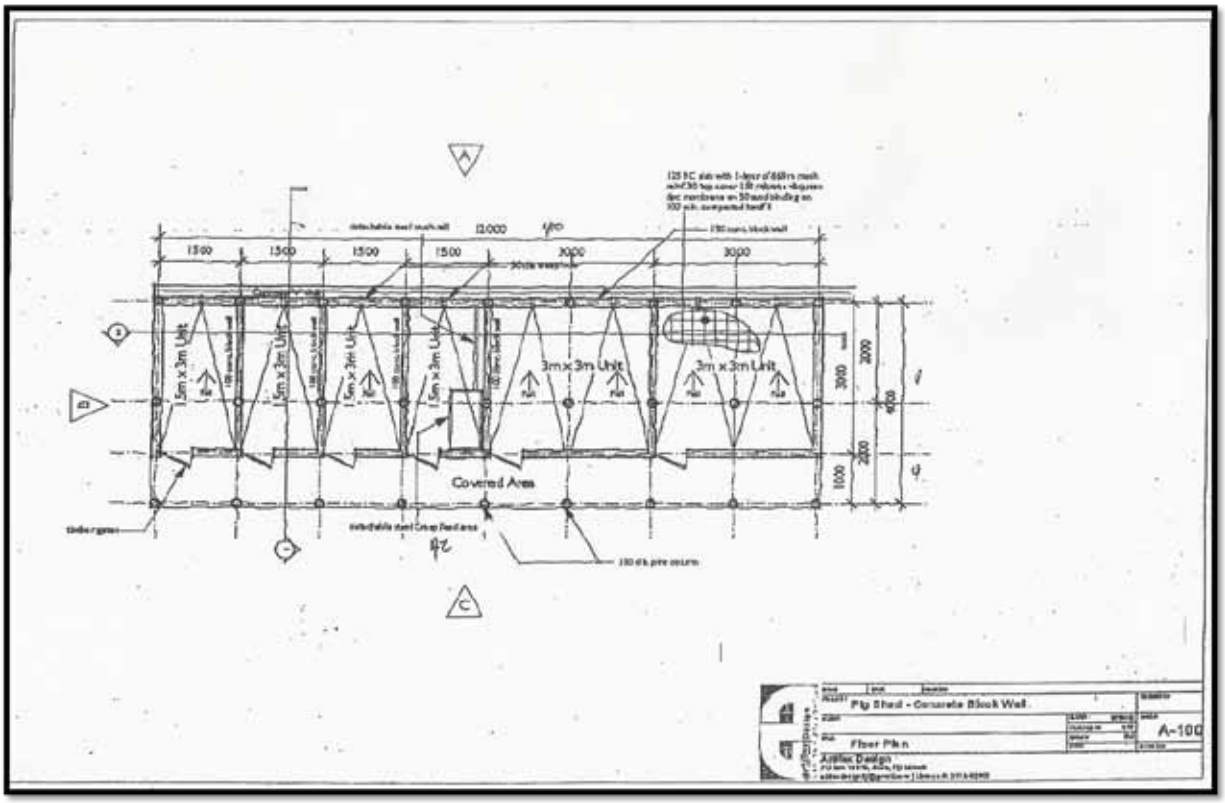



## 7.12 A 6 SOW UNIT PIGGERY SHED




timber purlins and rafters
150 dia. pine posts
concrete block wall
1000
Elevation C (Front View)
150 x 50 timber beam bolted to pine posts
150 dia. pine posts
150 conc. block wall
Reinforced concrete floor slab
1000
Elevation B (Side View)
Elevation A (Rear View)
Pig Shed - Concrete Block Wall
Elevations
A-300


Junction block binding detail
corner block binding detail
typ. purlin f king
view a
typ. rafter / beam f king detail
end detail 150 block wall
150 pine post
wrap post with dpc
underground level
d20 dowel
400 SQ
col. pad detail
typ. section
typ. section
Pig Shed - Concrete Block Wall
Typical Details
A-400




*(Source: Animal Health and Production Division, MoA, 2014)*

## Material List and Quotation

| Material List for a 6 Sow Unit Piggery Shed | | | | | |
|---|---|---|---|---|---|
| **No.** | **Item Description** | **Quantity** | **Unit** | **VIP Unit Price ($)** | **Total Costing ($)** |
| 1 | 17ft Roofing Iron Zincalume | 18 | sheets | 50.15 | 902.70 |
| 2 | Roofing Iron 65 x 3.75mm (Galvanised Plain) | 10 | kg | 6.3 | 63.00 |
| 3 | Neoprene Rubber Washer (100pcs/ pkt) | 10 | packet | 2.3 | 23.00 |
| 4 | Pine Posts 3.0 x 125mm | 27 | post | 51.87 | 1,400.49 |
| 5 | 6 x 2 Rough Rafter | 0.8393 | $m^3$ | 1056.76 | 886.94 |
| 6 | 6 x 2 Rough | 0.246 | $m^3$ | 1050.93 | 258.53 |
| 7 | 4 x 2 Rough | 0.2746 | $m^3$ | 1050.93 | 288.59 |
| 8 | 3 x 2 Rough | 0.1238 | $m^3$ | 1050.93 | 130.11 |
| 9 | 6 x 1 Rough | 0.204 | $m^3$ | 1153.15 | 235.24 |
| 10 | Pacific Cement 50kg bag | 80 | bag | 15 | 1,200.00 |
| 11 | Concrete Block Standard | 1150 | each | 1.81 | 2,081.50 |
| 12 | Balck Mesh Wire 6m x 2.4m x 666 | 4 | sheets | 91.45 | 365.80 |
| 13 | Deformed bars GR300 12mm x 6m (188 Length/ton) | 50 | length | 12.02 | 601.00 |
| 14 | Round Mild Steel 5mm x 5.5m | 20 | Length | 2.3 | 46.00 |
| 15 | Tradex Tee Hinges Z/P 6" (150mm) L/Duty C/W Screws | 6 | pair | 2.86 | 17.16 |
| 16 | Tradex Tee Hinges Z/P 6" (150mm) L/Duty C/W Screws | 3 | 1.94 | 5.82 | 17.46 |
| 17 | Polythene NZSTD | 200 | meter | 3.35 | 670.00 |

| | | | | | |
|---|---|---|---|---|---|
| 18 | Galvanised Socket A Grade 1/2" | 6 | each | 0.6 | 3.60 |
| 19 | Galvanised Union A Grade 15mm 1/2" | 8 | each | 3 | 24.00 |
| 20 | Galvanised Elbow A Grade 15mm (1/2") | 8 | each | 0.55 | 4.40 |
| 21 | Polythene NZSTD 15mm x 150m Thick Wall | 5 | meter | 3.35 | 16.75 |
| 22 | PVC Pressure Pipe CL 15 15mm x 5.6m S/E | 4 | Length | 5.18 | 20.72 |
| 23 | PVC Pressure Plain Elbow 15mm x 90DEG | 16 | each | 0.35 | 5.60 |
| 24 | PVC Pressure Valve Socket 15mm | 16 | each | 0.4 | 6.40 |
| 25 | PVC Pressure Faucet Socket 15mm | 16 | each | 0.4 | 6.40 |
| 26 | Pex Bibcock 1/2" Round Nose Brass #Pex-710 | 4 | each | 12.2 | 48.80 |
| 27 | V-Tech PVC Glue 500grams | 1 | each | 7.25 | 7.25 |
| 28 | Iplex Pressure R/Bush 25x15mm 824.25.15 | 1 | each | 1.25 | 1.25 |
| 29 | PVC 100mm x 5.6m SN4 Storm Water Pipe | 8 | length | 41 | 328.00 |
| 30 | PVC Waste Plain Bend 100mm x 90Deg | 8 | each | 5.25 | 42.00 |
| 31 | Iplex PVC Waste Pl/Junction 100mm Tee 90 Deg #104.100.88 | 6 | each | 11.5 | 69.00 |
| | **TOTAL** | | | | **$9,771.68** |

## 7.13 Freight Charges

| Destination | Kava | Dalo/Coconut |
|---|---|---|
| Kadavu to Suva | $1/kg | $4/bag |
| Gau to Suva | $1/kg | $5/bag |
| Koro to Suva | $1/kg | $5/bag |
| Taveuni to Suva | $1/kg | $6/bag |
| Savusavu to Suva | $1/kg | $6/bag |
| Vanuabalavu | $1/kg | $7/bag |

# CHAPTER 8.0
# FARMING FINANCE

## 8.1 FARM CAPITAL

The capital required to purchase a farm may range from a few hundred dollars to million of dollars depending upon size of farm, type of farm, land tenure and location. When purchasing a farm the prospective buyer will need to assess his capital requirements and it is useful to consider this according to three main Categories:-

Land and its improvements
Livestock and Machinery
Working Capital for Seasonal Operations

The division enables an orderly assessment of the capital requirement and also assists in deciding how finance for the purchase may be arranges. A farm purchaser may decide to borrow part of the sum needed and his ability to borrow will depend upon the following factors:

a) The type of title or tenure
b) Value of the assets for security purposes
c) The ownership organization
d) Lending policy of lending institutions
e) The ability to service the amount borrowed.

The above factors will also need to be taken into account when borrowing for purposes other than for purchase, such as for development purposes or for seasonal finance.
In these situations even more factors will have to be taken into account by the borrower and the lender, such as:-

f) Reason for borrowing
g) Type of farm and subsequent cash flow
h) Method of repayment
i) Sensitivity Changing production parameters

It must be remembered that for any lending proposition there will usually be more than one source of potential funding. Therefore a thorough consideration of all lending sources needs to be undertaken by the borrower.

A regular update is very more important because of the rapidly changing finance market that exists, especially for Agriculture.

This Chapter deals with the various **SOURCE OF FINANCE** available in Fiji.

## 8.2 FIJI DEVELOPMENT BANK

### 8.2.1 Introduction

The Fiji Development Bank (FDB) is the major agricultural lender.
The Bank came into being on 1.7.67 when it took over the assets and liabilities of the Agricultural and Industrial Loans Board. It is an independent statutory body operating under its own Board of Directors, but conducts its activities within the framework of the Government's general economic plans, policies and priorities. Its capital is wholly provided by the Government of Fiji, but in recent times the bulk of its resources have come from raising local and overseas loans.

The Bank is primarily a lending organization and under its Act must give priority to loans of an agricultural nature. In addition to providing short, medium and long term finance for agriculture and industry, its wide powers include investment in share and debentures, giving of guarantees, and underwriting issues of capital.

In particular the Bank seeks to assist with projects which have the effects of:

Creating employment
Promoting export oriented industries
Reducing imports
Diversifying the economy
Reducing income disparities
Utilizing the domestic raw materials.

The Bank is strongly recommended with the social and economic benefits that will flow to the Nation as a result of its operation. It seeks to obtain a reasonable degree of security but its requirements in that direction are flexible, and it is more concerned with the prospects of the project becoming and continuing to be successful.

Personal Factor
The personal factor is important in all loan applications. Bank officers must satisfy themselves that the applicant is credit worthy, possess the necessary skills and is capable of completing the proposed programme.

This may require applicants completing development from their own resources or creating.
–Sweat Equity (i.e. appreciable development by own labour) before an advance will be considered.

### 8.2.2 Types of Loans

Loans are available for a wide range of activities such as land clearing, bulldozing, drainage works, fencing and appropriate farm machinery and inputs to establish farms. In addition individuals or corporate entities can be assisted to develop land subdivision

schemes for identified agricultural commodities.
The following is a summary of the FDB lending criteria for the more common agricultural loans.

**8.2.2.1 Land Purchase**
The Bank may in special circumstances lend up to 50% of the purchase price exceeding $20,000 for agricultural land which will be brought into production or on which production will be increased by the new owners. Due to the high cost of land and the relatively unproductive use of loan funds, the Bank prefers applicants to acquire land from their own resources. In circumstances of land price below $20,000, 35% Cash equity is required.

**8.2.2.2 Land Development**
The Bank may advance up to 90% for genuine land development for agricultural purposes to farmers who have freehold or satisfactory leases. Land development includes land clearing drainage, pasture development and fencing.

**8.2.2.3 Farm House**
Loans up to a maximum of $20,000 are granted to successful farmers who are normally required to make some contribution of 10% of the Total Cost.

**8.2.2.4 Equipment, Implements, Tools.**
The Bank normally finances up to 90% of the purchase price of new equipment but may consider financing 100% in special circumstances and where adequate collateral is available. For machinery and farm vehicles, the institution can financed up to 65%.

### 8.2.3 Conditions and Terms of Loans

**8.2.3.1 Length of Loan**
Loan repayments may spread up to 15 years but they are usually tailored to suit the project. For some loans the term may be negotiable but in general they are set, depending on the purpose of the loan.

**8.2.3.2 Security**
The Bank requires a reasonable degree of security but is more concerned with the viability of the Project.
Usual types of security taken include the following:

a) A mortgage over the land or lease
b) Bill of Sale securing plant and livestock
c) Crop Lien – covering crop proceeds
d) Assignment of proceeds
e) Notification – a document that includes all of (a), (b) and (c)
f) Personal guarantor

**8.2.3.4 Interest Rates**
Interest rate is calculated on the daily loan balance debited monthly. The FDB reserves the right to vary the interest rate at any time, without notice during the currency of the loan. Borrowers who default on significant terms of loan may have the interest rate on their loans increased by withdrawal of the subsidy.

### 8.2.4 Other Loans

a) Where applicants are proven in ability the Bank may advance a small loan with the

view of making further advances subject to the farmer proving reliable.

b) In cases where development will extend over several years, the overall programme will be divided into phases, with separate loans approve, for each phase.

c) Supplementary loans are these which are made to supplement a previous advance.

### 8.2.5 Assistance to Clients Experiencing Hardship/Natural Disaster

To assist farmers who are experiencing difficulty with meeting commitments, the Bank may: Provide a grace period during development, during the time no principal repayments will be made. Re-schedule repayments as most appropriate to the particular need.

### 8.2.6 Drawing of Loans

The drawing of loan money in all cases is authorized by the Branch Manager upon satisfactory evidence provided by the Loan Officer.

### 8.2.7 LENDING FEES & CHARGES

#### 8.2.7.1 Housing Loans ( Suspended)

| | | |
|---|---|---|
| Application Fees | - | $50 |
| Establishment Fees | - | $500 |
| Line of Credit | - | $100 |
| Bank Service Fees | - | $20 per month |
| Re scheduling Visit Fees | - | $50 |
| Inspection Visit Fees | - | $100 |
| FNPF Transfer | - | $100 |
| Variation Fees | - | $30 |
| Security Documentation Fees | - | $400 |
| Memorandum Varying Priority of Mortgage | - | $50 |

#### 8.2.7.2 Social Banking Loans (Suspended)

| | Micro Credit | Agri Finance |
|---|---|---|
| Application Fees | $10 | $25 |
| Establishment Fees | $25 | $50 |
| Security Documentation Fees | nil | Max $50 |
| Bank Services Fees (month) | $1 | $5 |
| Discharge Fees | $30 | $30 |

### 8.2.8 Business Loans

**Application Fees:**

| | | |
|---|---|---|
| Up to $19,999 | - | $50 |
| $20,000 to $49,999 | - | $100 |
| $50,000 to $99,999 | - | $200 |

**Approval Fees**

| | | |
|---|---|---|
| More than $100,000 | - | $1000 |

**Establishment Fees**

| | | |
|---|---|---|
| Up to $4,999.99 | - | $150 |
| More than $5,000 to $19,999.99 | - | $200 |
| More than $20,000 to $49,999.99 | - | $350 |
| More than $50,000 | - | 1% of Loan Amount |

### 8.2.9 Other Loan Fees

Bank Service Fee (Charged on Quarterly Basis)

| | | |
|---|---|---|
| Up to $4,999 | - | $10/month |
| More than $5,000 to $19,999 | - | $12.50/month |
| More than $20,000 to $49,999.99 | - | $20/month |
| More than $50,000 to $99,999.99 | - | $40/month |
| More than $100,000 to $499,999.99 | - | $50/month |
| More than $500,000 to $999,999.99 | - | $100/month |
| More than $1m | - | 0.020/month |

**Bank Guarantee Facility Fees** - 5% per annum of the value of guarantee

**Loan Exit Fees**

Up to $19,999.99 - no exit fees

More than $200,000 - 3 months interest (minimum of $1000) on the prevailing rate based on the outstanding loan balance if the Bank is not given the prerequisite three months notice of your intention to repay before expiry of loan term.

Commitment Fees - 1% per annum on undrawn funds if not drawn within 3 months of acceptance of loan letter.

**Insurance Fees (on base premium)**

| | | |
|---|---|---|
| Motor vehicle and other Cover | - | 10% |
| House/Fire Cover | - | 15% (maximum fee of $1000) |
| Dishonored Cheque | - | $10 plus dishonored expense of operating bank |
| Printing of bank statement | - | $5 per page |
| Extension of Offer beyond 30 days | - | $100 |
| Photocopy Fee per page | - | $1 |
| Bank Opinion Fee | - | $50 |
| Audit Confirmation Certificate | - | $50 |
| Rescheduling Fee | - | $100 |

**Inspection Fees**

| | | |
|---|---|---|
| Focused Sector Loans | - | $40 |
| Non Focused Sector Loans | - | $70 |

**8.2.10 Security Documentation**

**A. New Loan/Prime Security**

| | | |
|---|---|---|
| Up to $49,999.99 | - | $400 |
| $50,000 - $99,999.99 | - | $800 |
| $100,000 - $499,999.99 | - | $1200 |
| $500,000 & above | - | $2500 |

(for collateral security, the fee shall be half of the prime security fee)

**B. Further Loans**

1. No Up Stamping
   Consent & Undertaking for security Adequacy - $50 per charge
2. Up-stamping

a) Individual & Other Entities

| | | |
|---|---|---|
| i) Up stamping | - | $100 |
| ii) Consent & Undertaking | - | $50 per charge |

b) Companies

| | | |
|---|---|---|
| i) Up- Stamping | - | $100 |
| ii) Consent & Undertaking | - | $50 per charge |

| | | |
|---|---|---|
| iii) Particulars of Charge | - | $25 per charge |
| iv) Resolution | - | $50 per company. |
| | | |
| **C.** Added Collateral Security | - | $200 |
| D. Added charges All Company Securities | | |
| 1) Guarantee | - | $100 per document |
| 2) **All Company Security** | | |
| a) Particulars of Charge | - | $25 per charge |
| b) Resolution | - | $50 per charge |
| | | |
| **Deed of priority fee :** | | |
| Up to $199,999.99 | - | $200 |
| $200,000 - $499,999.99 | - | $300 |
| $500,000 and above | - | $500 |
| **Settlement** | | |
| Up to $499,999.99 | - | $100 |
| Over $50,000 | - | $300 |
| **Hire Purchase** | | |
| Up to $99,999.99 | - | $100 |
| More than $50,000 | - | $300 |
| | | |
| Sales and Purchase Agreement & Other Mortgage related docs | - | $250 |
| Release of Guarantee | - | $50 per guarantor |
| Mortgage Variation Fees | - | $50 |
| Bank Guarantee Fee | - | $400 |
| Release of Bank Guarantee | - | $100 |
| SEFP World Bank Guarantee Fee | | |
| Up to $99,999.99 | - | $200 |
| More than $100,000 | - | $500 |
| Title Production Fee (mortgage related) | $100 | |
| Renewal of Security - Service Fee: | | |
| 1. Notification/Crop lien | - | $150 |
| 2. Bill of Sale | | |
| Up to $4,999.99 | - | $100 |
| $5,000 to $9,999.99 | - | $150 |
| $10,000 to $24,999.99 | - | $200 |
| $25,000 - $49,999.99 | - | $250 |
| above $50,000 | - | $300 |
| Search Fees | | |
| Company Search | - | $40 |
| Others | - | $15 |

**Discharge Fees**

a) **Crop Lien/Notification (over crops & chattles/lease & titles)**

| | | |
|---|---|---|
| - Full Discharge | - | $100 |
| - Partial or Conditional Charge | - | $100 per charge |

b) **Bill of Sale, Mortgage, Ships Mortgages, Lien, Assignment, Guarantee, Debenture**

| | | |
|---|---|---|
| Full Charge | - | $200/charge plus $50 for each additional document |
| Partial of Conditional Discharge document. | - | $ 150 per Charge plus $100 for each additional |
| Memo of Satisfaction | - | $50 per charge |

| | | |
|---|---|---|
| Settlement Letter | - | $50 per charge |
| Letter of Cancellation | - | $25 |
| Caveat | - | $200 |
| Removal/Withdrawal of Caveat | - | $50 |
| Transmission by Death | - | $100 |

**8.2.11 DEFAULTING CHARGES**

| | | |
|---|---|---|
| Arrears Fee | - | $25 per default if arrears > 30days |
| Demand Notice Fee | - | $150 |

## 8.3 Commercial Bank Lending

There are six (6) commercial trading banks operating in Fiji.

These are:-

- ***Westpac Banking Corporation***
- ***Australia & New Zealand Banking Group***
- ***Bank of the South Pacific***
- ***Bank of Baroda***
- ***Bred Bank***
- ***Home Finance Bank***

Each bank has different and changing lending policies. Prospective lenders should consult the bank's representatives to find our more detailed information on lending policies.

You are recommended to refer any enquires to any Commercial Bank if you wish to have credit access.

# CHAPTER 9.0
# GROSS MARGIN - CROPS

## 9.1 INTRODUCTION

The gross margin presented in the two chapters are designed to give an overview of the profitability of crops and livestock enterprises in Fiji. The easiest type of financial analysis for small farmers to do is what is called Gross Margin Analysis. It is a tool for the farmer who wants some idea of how profitable the enterprise is. The word "profitable" is put in inverted commas because Gross Margin analysis does take into account variable cost only without accounting for the fixed costs. True or real profit is only found when both variable and fixed cost are subtracted from the value of production.

***Therefore Gross Margin = Value of Production - Variable Cost.***

Because of the sensitivity of the calculations to changing costs and prices, and the seasonal changes in production, the gross margins presented should only be used as a guide; showing the form of calculation, and indicating likely responses.

Further, it is emphasized here that the gross margin, in common with other performance measures, is rarely sufficient for management decisions, if used independently. However, if valued and compared within the system of enterprises, and production factors, it has been proven to be invaluable as an original measure of performance, in absolute and relative terms.

A farm management database and information system will be established of which provincial figures will be collated and analyzed continuously to capture the changing nature of prices and input costs.

The enterprise budget shown in the Gross Margin Analysis should be used to prepare Whole Farm Budgets or Farming Systems Budget where the fixed costs of the business is incorporated and profitability status is determined.

# 9.1 Gross Margin for Carrots

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 100,000 |
| | *Assumptions* | | | | |
| 1 | Spacing | 0.5m x 0.2m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha | kg | 12000 | | |
| | Production | kg | 12000 | | |
| | Marketable Production (90%) | kg | 10800 | | 10,800 |
| | Price/kg | $ | 2.5 | | |
| | **Gross Value of Output** | **$** | **27000** | | **27,000** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Diuron | kg | 1.5 | 34.68 | **52.0** |
| | Kocide | kg | 2.25 | 35.65/500g | **160.4** |
| | Suncloprid | ltr | 0.18 | 32.88 | **5.9** |
| | Sunthene | g | 500 | 5.04/100grams | **25.2** |
| | | | | | |
| | Seeds | kg | 2.5 | 5/20g | **625** |
| | | | | | |
| | **Total Input Costs** | | | | **2873.70** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Sowing/Thinning | personday | 40 | 20 | **800** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **156** | | **3,120** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **8,574** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$18,426** |
| 9 | **Return/Labour Inputs** | **$** | | | **$118.12** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.71** |
| 11 | **Breakeven Yield** | **kg** | | | **3429.48136** |

**SENSITIVITY ANALYSIS**

| Carrot - Yield (kg/ha) | Marketable Yield 90% | Price($/kg) | Price($/kg) | Price($/kg) |
|---|---|---|---|---|
| | | 1.5 | 2.5 | 3.5 |
| 8000 | 7200 | 2226 | 9426 | 16626 |
| 10000 | 9000 | 4926 | 13926 | 22926 |
| 12000 | 10800 | 7626 | 18426 | 29226 |
| 14000 | 12600 | 10326 | 22926 | 35526 |

# 9.2 Gross Margin for Capsicum

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | Plant Density : 20,000 plants |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 1m x 0.5m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 12000 | | |
| | Production (Fresh) | kg | 12000 | | |
| | Marketable Production (90%) | kg | 10800 | | 10,800 |
| | Price/kg | $ | 4 | | |
| | **Gross Value of Output** | **$** | **43200** | | **43,200** |
| | | | | | |
| | | **Unit** | **Quantity** | **Unit Cost** | **Total Costs** |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Benomyl | g | 300 | 5.68/100grams | **17** |
| | Sunthene | g | 500 | 5.04/100g | **25.2** |
| | | | | | |
| | Seeds | grams | 300 | 5.50/20g | **82.5** |
| | | | | | |
| | **Total Input Costs** | | | | **2129.88** |
| | | | | | |
| 4 | **Machinery Inputs** | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | | | | | |
| | Seedbed Preparation | personday | 1 | 20 | **20** |
| | Transplanting/Planting | personday | 30 | 20 | **600** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **147** | | **2,940** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **7,649.88** |
| 8 | **Gross Margin/ha** | **$** | | | **35,550.12** |
| 9 | **Return/Labour Input** | **$** | | | **$241.84** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.64** |
| 11 | **Breakeven Yield** | **kg** | | | **1,912** |

**SENSITIVITY ANALYSIS**

| Capsicum - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | |
|---|---|---|---|---|---|
| | | | 2 | 3 | 4 |
| 1 | 6000 | 5400 | 3,150 | 8,550 | 13,950 |
| 2 | 8000 | 7200 | 6,750 | 13,950 | 21,150 |
| 3 | 10000 | 9000 | 10,350 | 19,350 | 28,350 |
| 4 | 12000 | 10800 | 13,950 | 24,750 | 35,550 |

# 9.3 Gross Margin for Chillies

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | Plant Density : 33,333 plants |
| | *Assumptions* | | | | |
| 1 | Spacing | 1m x 0.3m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 16000 | | |
| | Production (Fresh) | kg | 16000 | | |
| | Marketable Production (90%) | kg | 14400 | | 14,400 |
| | Price/kg | $ | 2 | | |
| | **Gross Value of Output** | **$** | **28800** | | **28,800** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Paraquat | litre | 3 | 19.2 | **48** |
| | Sundomil | kg | 1.25 | 18.64/500g | **46.6** |
| | Mancozeb | kg | 0.55 | 23.94 | **13.17** |
| | Suncloprid 20SL | litre | 0.19 | 32.88/ltr | **6.17** |
| | Sunthene | gram | 0.50 | 5.04/100g | **25.20** |
| | | | | | |
| | Seeds | g | 300 | 1.45/20g | **21.75** |
| | | | | | |
| | **Total Input Costs** | | | | **2166** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Seedbed Preparation | personday | 1 | 20 | **20** |
| | Transplanting/Planting | personday | 30 | 20 | **600** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **147** | | **2,940** |
| | | | | | |
| 6 | Transport Expense | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **7,686** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$21,114** |
| 9 | **Return/Labour Inputs** | **$** | | | **$143.63** |
| 10 | **Breakeven Price/kg** | **$** | | | **0.48** |
| 11 | **Breakeven Yield** | **kg** | | | **3,843** |

**SENSITIVITY ANALYSIS**

| Chillies - Yield (kg/ha) | Marketable Yield 90% | Price($/kg) | Price($/kg) | Price($/kg) |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| 8,000 | 7,200 | -486 | 6,714 | 13,914 |
| 10,000 | 9,000 | 1,314 | 10,314 | 19,314 |
| 14,000 | 12,600 | 4,914 | 17,514 | 30,114 |
| 16,000 | 14,400 | 6,714 | 21,114 | 35,514 |

# 9.4 Gross Margin for Chinese Cabbage

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 44,440 |
| | *Assumptions* | | | | |
| 1 | Spacing | 75cm x 30cm | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha | kg | 12000 | | |
| | Production | kg | 12000 | | |
| | Marketable Production (90%) | kg | 10800 | | 10,800 |
| | Price/kg | $ | 1.5 | | |
| | **Gross Value of Output** | **$** | **16200** | | **16,200** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 5000 | 3.5/25kg | **700** |
| | Mancozeb (Dithane M45) | kg | 0.55 | 22.3 | **12.28** |
| | Steward | litre | 0.19 | 333.49 | **62.53** |
| | Suncloprid 20 SL | litre | 0.19 | 32.88 | **6.17** |
| | | | | | |
| | Seeds | grams | 300 | 1.5/30g | **15** |
| | | | | | |
| | **Total Input Costs** | | | | **1401** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Seedbed sowing | personday | 1 | 20 | **20** |
| | Planting | personday | 30 | 20 | **600** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **146** | | **2,940** |
| | | | | | |
| 6 | Transport | trip | 2 | 500 | **1,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **5,921** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$10,279** |
| 9 | **Return/Labour Inputs** | **$** | | | **$70** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.49** |
| 11 | **Breakeven Yield** | **kg** | | | **3,947** |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | | | | | |
| | **Chinese Cabbage - Yield (kg/ha)** | **Marketable Yield 90%** | **Price/kg 1.5** | **Price/kg 2.5** | **Price/kg 3.5** |
| | 6000 | 5400 | 2,179 | 7,579 | 12,979 |
| | 8000 | 7200 | 4,879 | 12,079 | 19,279 |
| | 10000 | 9000 | 7,579 | 16,579 | 25,579 |
| | 12000 | 10800 | 10,279 | 21,079 | 31,879 |

# 9.5 Gross Margin for Cucumber

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | Plant Density : 33,333 plants |
| | *Assumptions* | | | | |
| 1 | Spacing | | 1m x 0.3m | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 12000 | | |
| | Production (Fresh) | kg | 12000 | | |
| | Marketable Production (90%) | kg | 10800 | | 10,800 |
| | Price/kg | $ | 3 | | |
| | **Gross Value of Output** | **$** | **32400** | | **32,400** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40 | **190** |
| | Poultry Manure | kg | 5000 | 3.5/25kg | **700** |
| | Mancozeb | kg | 0.55 | 23.94/kg | **13** |
| | Kocide | kg | 2.25 | 35.65/500g | **160** |
| | Rogor | litre | 0.4 | 32.77/ltr | **13.1** |
| | | | | | |
| | Seeds ( Cucumber Hybrid) | kg | 2 | 8.8/10g | **1760** |
| | | | | | |
| | **Total Input Costs** | | | | **3252** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | **14.5** | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Planting | personday | 30 | 20 | **600** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 30 | 20 | **600** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **126** | | **2,520** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **8,352** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$24,048** |
| 9 | **Return/Labour Inputs** | **$** | | | **$190.86** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.70** |
| 11 | **Breakeven Yield** | **kg** | | | **2784** |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | | | | | |
| | **Cucumber - Yield (kg/ha)** | **Marketable Yield 90%** | **Price/kg 1.5** | **Price/kg 2.5** | **Price/kg 3** |
| | 6000 | 5400 | -252 | 5,148 | 7,848 |
| | 8000 | 7200 | 2,448 | 9,648 | 13,248 |
| | 10000 | 9000 | 5,148 | 14,148 | 18,648 |
| | 12000 | 10800 | 7,848 | 18,648 | 24,048 |

# 9.6 Gross Margin for Duruka

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Traditional Farming System*** | | | | |
| | ***Assumptions*** | | | | |
| **1** | Spacing | 1.3m x 0.3m | | | |
| | | | | | |
| **2** | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | bundles | 2560 | | |
| | Production (Fresh) | bundles | 2560 | | |
| | Price/kg | $ | 4 | | |
| | **Gross Value of Output** | **$** | **10240** | | **10,240** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| **3** | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | Super Phosphate | kg | 225 | 28.77/25kg | **259** |
| | Urea | kg | 200 | 76.04/25kg | **608** |
| | Diuron | kg | 3 | 66.94/2kg | **200.8** |
| | Sunthene | kg | 0.50 | 5.04/100g | **25.2** |
| | Planting Material | cuttings | 25,641 | 0.05 | **1282.05** |
| | | | | | |
| | **Total Input Costs** | | | | **2375** |
| | | | | | |
| **4** | **Labour Inputs** | | | | |
| | Land Clearing | personday | 25 | 20 | **500** |
| | Digging & Planting | personday | 15 | 20 | **300** |
| | Fertiliser Application | personday | 8 | 20 | **160** |
| | Interrow Cultivation | personday | 8 | 20 | **160** |
| | Harvesting | personday | 20 | 20 | **400** |
| | Sorting & Bundling | personday | 5 | 20 | **100** |
| | **Total Labour Days @ $20/personday** | | **56** | | **1,620** |
| | | | | | |
| **5** | Transport | trip | 3 | 500 | **1,500** |
| | | | | | |
| **6** | **Total Variable Costs** | **$** | | | **5,495** |
| **7** | **Gross Margin/ha including Labour** | **$** | | | **$4,745** |
| **8** | **Return/Labour Inputs** | **$** | | | **$84.73** |
| **9** | **Breakeven Price/kg** | **$** | | | **$2.15** |
| **10** | **Breakeven Yield** | **bundle** | | | **1,374** |
| | | | | | |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | | | | | |
| | **Duruka - Yield (bundles/ha)** | **Price/kg** | **Price/kg** | **Price/kg** | |
| | | **2** | **3** | **4** | |
| | 1060 | -3,375 | -2,315 | -1,255 | |
| | 1560 | -2,375 | -815 | 745 | |
| | 2060 | -1,375 | 685 | 2,745 | |
| | 2560 | -375 | 2,185 | 4,745 | |

# 9.7 Gross Margin for English Cabbage

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 22,222 |
| | *Assumptions* | | | | |
| 1 | Spacing | 0.75m x 0.45m - 0.6m | | | |
| | | | | | |
| 2 | **Production & Income Schedule** | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha | kg | 15000 | | |
| | Production | kg | 15000 | | |
| | Marketable Production (90%) | kg | 13500 | | 13,500 |
| | Price/kg | $ | 2 | | |
| | **Gross Value of Output** | **$** | **27000** | | **27,000** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 5000 | 3.5/25kg | **700** |
| | Kocide | kg | 2 | 35.65/500g | **142.6** |
| | Steward 150SC | litre | 0.19 | 333.49/ltr | **63.4** |
| | | | | | |
| | Seeds | g | 300 | 26.5/20g | **397.5** |
| | | | | | |
| | **Total Input Costs** | | | | **1909** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Seed bed preparation | personday | 1 | 20 | **20** |
| | Transplanting/Planting | personday | 30 | 20 | **600** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **146** | | **2,940** |
| | | | | | |
| 6 | Transport | trip | 3 | 500 | **1,500** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$6,929** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$20,071** |
| 9 | **Return/Labour Inputs** | **$** | | | **$137** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.46** |
| 11 | **Breakeven Yield** | **kg** | | | **3,464** |
| | | | | | |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | **English Cabbage - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg)** | **Price($/kg)** | **Price($/kg)** |
| | | | **1** | **2** | **3** |
| | 13000 | 11700 | 4,771 | 16,471 | 28,171 |
| | 14000 | 12600 | 5,671 | 18,271 | 30,871 |
| | 15000 | 13500 | 6,571 | 20,071 | 33,571 |
| | 16000 | 14400 | 7,471 | 21,871 | 36,271 |

# 9.8 Gross Margin for Eggplant

| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 13,333 plants |
|---|---|---|---|---|---|
| | *Assumptions* | | | | |
| 1 | Spacing | 1.5m x 0.5m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 20000 | | |
| | Production (Fresh) | kg | 20000 | | |
| | Marketable Production (90%) | kg | 18000 | | 18,000 |
| | Price/kg | $ | 1 | | |
| | **Gross Value of Output** | **$** | **18000** | | **18,000** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Paraquat | litre | 3 | 19.17 | **48** |
| | Kocide | kg | 2 | 35.65/500g | **142.60** |
| | Diazinon | litre | 1.13 | 21.70 | **24.41** |
| | Sunthene | kg | 0.50 | 5.04/100grams | **25.20** |
| | | | | | |
| | Seeds | g | 300 | 8.5/10g | **255** |
| | | | | | |
| | **Total Input Costs** | | | | **2500** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Seedbed Preparation | personday | 1 | 20 | **20** |
| | Transplanting/Planting | personday | 25 | 20 | **500** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **142** | | **2,840** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$7,920** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$10,080** |
| 9 | **Return/Labour Inputs** | **$** | | | **$71** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.40** |
| 11 | **Breakeven Yield** | **kg** | | | **7,920.28** |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | | | | | |
| | **Eggplant - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg)** | **Price($/kg)** | **Price($/kg)** |
| | | | **0.6** | **1** | **1.4** |
| | 14000 | 12600 | -360 | 4,680 | 9,720 |
| | 16000 | 14400 | 720 | 6,480 | 12,240 |
| | 18000 | 16200 | 1,800 | 8,280 | 14,760 |
| | 20000 | 18000 | 2,880 | 10,080 | 17,280 |

# 9.9 Gross Margin for French Bean

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 100,000 |
| | *Assumptions* | | | | |
| 1 | Spacing | 0.5m x 0.15m - 0.2m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha | kg | 10000 | | |
| | Production | kg | 10000 | | |
| | Marketable Production (90%) | kg | 9000 | | 9,000 |
| | Price/kg | $ | 3.5 | | |
| | **Gross Value of Output** | **$** | **31500** | | **31,500** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Benomyl | kg | 1 | 5.68/100g | **56.8** |
| | Kocide | kg | 2 | 35.65/500g | **142.6** |
| | Suncloprid 20 SL | litre | 0.19 | 32.88/ltr | **6.2** |
| | | | | | |
| | Seeds | kg | 45 | 9.60 | **432** |
| | | | | | |
| | **Total Input Costs** | | | | **2643** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Planting | personday | 30 | 20 | **600** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **146** | | **2,920** |
| | | | | | |
| 6 | Transport | trip | 3 | 500 | **1,500** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$7,643** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$23,857** |
| 9 | **Return/Labour Inputs** | **$** | | | **$163** |
| 10 | **Breakeven Price/kg** | **$** | | | **$1** |
| 11 | **Breakeven Yield** | **kg** | | | **2,184** |
| | | | | | |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | | | | | |
| | **French Bean - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg)** | **Price($/kg)** | **Price($/kg)** |
| | | | **2** | **3** | **4** |
| | 5000 | 4500 | 1,357 | 5,857 | 10,357 |
| | 6000 | 5400 | 3,157 | 8,557 | 13,957 |
| | 7000 | 6300 | 4,957 | 11,257 | 17,557 |
| | 10000 | 9000 | 10,357 | 19,357 | 28,357 |

# 9.10 Gross Margin for Lettuce

| | | | | | |
|---|---|---|---|---|---|
| | **Gross Margin for Lettuce** ***(Lactuca sativa)*** | | | | |
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 33,333 plants |
| | ***Assumptions*** | | | | |
| 1 | **Spacing** | **75cm x 40cm** | | | |
| | | | | | |
| 2 | **Production & Income Schedule** | | | | **Total** |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 10000 | | |
| | Production (Fresh) | kg | 10000 | | |
| | Marketable Production (90%) | kg | 9000 | | 9,000 |
| | Price/kg | $ | 2 | | |
| | **Gross Value of Output** | **$** | **18000** | | **18,000** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 5000 | 3.5/25kg | **700** |
| | Benomyl | kg | 0.25 | 5.68/100g | **14.2** |
| | Kocide | kg | 2 | 35.65/500g | **142.6** |
| | Suncloprid 20SL | litre | 0.40 | 32.88/ltr | **13.2** |
| | | | | | |
| | Seeds | g | 300 | 7.5/10g | **225** |
| | | | | | |
| | **Total Input Costs** | | | | **1700** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | **14.5** | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Seedbed Preparation | personday | 1 | 20 | **20** |
| | Transplanting/Planting | personday | 30 | 20 | **600** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **147** | | **2,940** |
| | | | | | |
| 6 | Transport | trip | 3 | 500 | **1,500** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **6,720** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$11,280** |
| 9 | **Return/Labour Inputs** | **$** | | | **$76.73** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.67** |
| 11 | **Breakeven Yield** | **kg** | | | **3360** |
| | | | | | |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | **Lettuce - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg) 1** | **Price($/kg) 2** | **Price($/kg) 4** |
| | 4000 | 3600 | -3,120 | 480 | 7,680 |
| | 6000 | 5400 | -1,320 | 4,080 | 14,880 |
| | 8000 | 7200 | 480 | 7,680 | 22,080 |
| | 10000 | 9000 | 2,280 | 11,280 | 29,280 |

# 9.11 Gross Margin for Long Bean

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 33,333 |
| | *Assumptions* | | | | |
| **1** | Spacing | | 1m x 0.3m | | |
| | | | | | |
| **2** | Production & Income Schedule | | | | Total |
| | Area | hectare | 1 | | 1 |
| | Yield/ha | kg | 10000 | | 10000 |
| | Production | kg | 10000 | | 10000 |
| | Marketable Production (90%) | kg | 9000 | | 9,000 |
| | Price/kg | $ | 2 | | 2 |
| | **Gross Value of Output** | **$** | **18000** | | **18,000** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| **3** | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Tzar | ltr | 1.13 | 32.74/ltr | **37.0** |
| | Kocide | kg | 2 | 35.65/500g | **142.6** |
| | Lannate | litre | 0.75 | 96.94/ltr | **72.7** |
| | | | | | |
| | Seeds | kg | 7.00 | 28.50 | **199.5** |
| | | | | | |
| | **Total Input Costs** | | | | **2457** |
| | | | | | |
| **4** | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| **5** | Labour Inputs | | | | |
| | Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Weeding | personday | 15 | 20 | **300** |
| | Staking | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **151** | | **3,020** |
| | | | | | |
| **6** | Transport | trip | 2 | 500 | **1,000** |
| | | | | | |
| **7** | **Total Variable Costs** | **$** | | | **7,057** |
| **8** | **Gross Margin/ha including Labour** | **$** | | | **$10,943** |
| **9** | **Return/Labour Inputs** | **$** | | | **$72.47** |
| **10** | **Breakeven Price/kg** | **$** | | | **$0.71** |
| **11** | **Breakeven Yield** | **kg** | | | **3528** |

| SENSITIVITY ANALYSIS | | | | | |
|---|---|---|---|---|---|
| **Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg) 1** | **Price($/kg) 2** | **Price($/kg) 4** | |
| 4000 | 3600 | -3457 | 143 | 7343 | |
| 6000 | 5400 | -1657 | 3743 | 14543 | |
| 8000 | 7200 | 143 | 7343 | 21743 | |
| 10000 | 9000 | 1943 | 10943 | 28943 | |

# 9.12 Gross Margin for Okra

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 33,333 plants |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 1m x 0.3m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 15000 | | |
| | Production (Fresh) | kg | 15000 | | |
| | Marketable Production (90%) | kg | 13500 | | 13,500 |
| | Price/kg | $ | 1.5 | | |
| | **Gross Value of Output** | **$** | **20250** | | **20,250** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Benomyl | kg | 0.25 | 5.68/100 g | **14** |
| | Suncloprid 20SL | ltr | 0.20 | 32.88/ltr | **6.58** |
| | Sunthene | kg | 0.50 | 5.04/100g | **25.20** |
| | | | | | |
| | Seeds | kg | 8 | 19/489g | **311** |
| | | | | | |
| | **Total Input Costs** | | | | **2362** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | | | | | |
| | Planting | personday | 25 | 20 | **500** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Inter row cultivation | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **141** | | **2,820** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$7,762** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$12,488** |
| 9 | **Return/Labour Inputs** | **$** | | | **$88.57** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.52** |
| 11 | **Breakeven Yield** | **kg** | | | **5,175** |
| | | | | | |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | **Okra - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg)** | **Price($/kg)** | **Price($/kg)** |
| | | | **1** | **2** | **4** |
| | 9000 | 8100 | 338 | 8,438 | 24,638 |
| | 11000 | 9900 | 2,138 | 12,038 | 31,838 |
| | 13000 | 11700 | 3,938 | 15,638 | 39,038 |
| | 15000 | 13500 | 5,738 | 19,238 | 46,238 |
| | | | | | |

# 9.13 Gross Margin for Pumpkin

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 3086 plants |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 1.8m x 1.8m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 15000 | | |
| | Production (Fresh) | kg | 15000 | | |
| | Marketable Production (90%) | kg | 13500 | | 13,500 |
| | Price/kg | $ | 2 | | |
| | **Gross Value of Output** | **$** | **27000** | | **27,000** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 12000 | 3.5/25kg | **1680** |
| | Benomyl | litre | 0.25 | 5.68/100g | **14.2** |
| | Sunthene | kg | 0.50 | 5.04/100g | **25.2** |
| | | | | | |
| | Seeds | kg | 1.50 | 12.5/10g | **1875** |
| | | | | | |
| | **Total Input Costs** | | | | **4200** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | | | | | |
| | Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Hand Weeding | personday | 20 | 20 | **400** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **136** | | **2,720** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **9,500** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$17,500** |
| 9 | **Return/Labour Inputs** | **$** | | | **$129** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.63** |
| 11 | **Breakeven Yield** | **kg** | | | **4750** |
| | | | | | |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | **Pumpkin - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg)** | **Price($/kg)** | **Price($/kg)** |
| | | | **1** | **2** | **4** |
| | 9000 | 8100 | -1,400 | 6,700 | 22,900 |
| | 11000 | 9900 | 400 | 10,300 | 30,100 |
| | 13000 | 11700 | 2,200 | 13,900 | 37,300 |
| | 15000 | 13500 | 4,000 | 17,500 | 44,500 |
| | | | | | |

# 9.14 Gross Margin for Radish

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | Plant Density : 400,000 plants |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 50cm x 5cm | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 15000 | | |
| | Production (Fresh) | kg | 15000 | | |
| | Marketable Production (90%) | kg | 13500 | | 13,500 |
| | Price/kg | $ | 1.3 | | |
| | **Gross Value of Output** | **$** | **17550** | | **17,550** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 5000 | 3.5/25kg | **700** |
| | | | | | |
| | Seeds | kg | 10.00 | 21.50 | **215** |
| | | | | | |
| | **Total Input Costs** | | | | **1520** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | **14.5** | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | | | | | |
| | Sowing/Thinning | personday | 40 | 20 | **800** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Inter row cultivation | personday | 15 | 20 | **300** |
| | Harvesting | personday | 30 | 20 | **600** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **116** | | **2,320** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$6,420** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$11,130** |
| 9 | **Return/Labour Inputs** | **$** | | | **$95.95** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.43** |
| 11 | **Breakeven Yield** | **kg** | | | **4,939** |
| | | | | | |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | **Radish - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg)** | **Price($/kg)** | **Price($/kg)** |
| | | | **0.8** | **1.3** | **1.5** |
| | 9000 | 8100 | 60 | 4,110 | 5,730 |
| | 11000 | 9900 | 1,500 | 6,450 | 8,430 |
| | 13000 | 11700 | 2,940 | 8,790 | 11,130 |
| | 15000 | 13500 | 4,380 | 11,130 | 13,830 |
| | | | | | |

# 9.15 Gross Margin for Tomato

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | Plant Density : 25,000 plants |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 1m x 0.4m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 15000 | | |
| | Production (Fresh) | kg | 15000 | | |
| | Marketable Production (90%) | kg | 13500 | | 13,500 |
| | Price/kg | $ | 2 | | |
| | **Gross Value of Output** | **$** | **27000** | | **27,000** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 12000 | 3.5/25kg | **1680** |
| | Mancozeb ( Dithane M45) | kg | 1.25 | 23.94 | **29.93** |
| | Kocide | kg | 2 | 35.7 | **71.3** |
| | Malathion | ltr | 2 | 22.2 | **44.4** |
| | Steward 150 SC | ltr | 0.19 | 38.3 | **7.2** |
| | Suncis | ltr | 0.30 | 28.4 | **8.5** |
| | | | | | |
| | Seeds | grams | 300 | 17.6/10 | **528** |
| | | | | | |
| | **Total Input Costs** | | | | **2974** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Seedbed Preparation | personday | 1 | 20 | **20** |
| | Transplanting/Planting | personday | 25 | 20 | **500** |
| | Fertiliser Application | personday | 15 | 20 | **300** |
| | Spraying | personday | 15 | 20 | **300** |
| | Staking | personday | 10 | 20 | **200** |
| | Interow Cultivation | personday | 15 | 20 | **300** |
| | Harvesting | personday | 50 | 20 | **1,000** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **147** | | **2,940** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **8,494** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$18,506** |
| 9 | **Return/Labour Inputs** | **$** | | | **$125.89** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.57** |
| 11 | **Breakeven Yield** | **kg** | | | **4,247** |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | **Radish - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg) 1.5** | **Price($/kg) 2** | **Price($/kg) 2.5** |
| | 9,000 | 8,100 | 3,656 | 7,706 | 11,756 |
| | 11,000 | 9,900 | 6,356 | 11,306 | 16,256 |
| | 13,000 | 11,700 | 9,056 | 14,906 | 20,756 |
| | 15,000 | 13,500 | 11,756 | 18,506 | 25,256 |

# 9.16 Gross Margin for Cassava - (Mechanised)

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | Plant Density : 20,000 |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 1m x 0.5m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 25000 | | |
| | Production (Fresh) | kg | 25000 | | |
| | Marketable Production (90%) | kg | 22500 | | 22,500 |
| | Price/kg | $ | 1.2 | | |
| | **Gross Value of Output** | **$** | **27000** | | **27,000** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Paraquat | litre | 4 | 19.17 | **76.68** |
| | Suncis | litre | 0.50 | 15.83/litre | **7.92** |
| | | | | | |
| | Planting Material | cuttings | 20000 | 0.05 | **1000** |
| | | | | | |
| | **Total Input Costs** | | | | **3090** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 9 | 20 | **180** |
| | Weed Control | personday | 10 | 20 | **200** |
| | Harvesting | personday | 20 | 20 | **400** |
| | Grading and Sorting | personday | 6 | 20 | **120** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **71** | | **1,420** |
| 6 | Transport | trip | 5 | 500 | **2,500** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$7,590** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$19,410** |
| 9 | **Return/Labour Inputs** | **$** | | | **$273.38** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.30** |
| 11 | **Breakeven Yield** | **kg** | | | **6,325** |
| | | | | | |
| 12 | ***Establishment Cost*** | | | | |
| | **Planting Materials** | | | | **$1,000** |
| | **Land Preparation** | | | | **$580** |
| | **Labour** | | | | **$1,420** |
| | **Total C** | | | | **$3,000** |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | **Cassava - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg) 0.7** | **Price($/kg) 1.2** | **Price($/kg) 1.5** |
| | 15,000 | 13,500 | 1,860 | 8,610 | 12,660 |
| | 20,000 | 18,000 | 5,010 | 14,010 | 19,410 |
| | 25,000 | 22,500 | 8,160 | 19,410 | 26,160 |
| | 30,000 | 27,000 | 11,310 | 24,810 | 32,910 |

# 9.17 Gross Margin for Cassava (Traditional)

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Traditional Farming System*** | | | | Plant Density : 10,000 mounds |
| | ***Assumptions*** | | | | |
| **1** | Spacing | | 1m x 1m | | |
| | | | | | |
| **2** | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 30000 | | |
| | Production (Fresh) | kg | 30000 | | |
| | Marketable Production (90%) | kg | 27000 | | 27,000 |
| | Price/kg | $ | 1.2 | | |
| | **Gross Value of Output** | **$** | **32400** | | **32,400** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| **3** | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Paraquat | litre | 4 | 19.17 | **76.68** |
| | Suncis | litre | 0.50 | 15.83/litre | **7.92** |
| | | | | | |
| | Planting Material | cuttings | 20000 | 0.05 | **1000** |
| | | | | | |
| | **Total Input Costs** | | | | **3090** |
| | | | | | |
| | | | | | |
| **5** | **Labour Inputs** | | | | |
| | Land Clearing | personday | 20 | 20 | **400** |
| | Digging & Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 9 | 20 | **180** |
| | Weed Control | personday | 10 | 20 | **200** |
| | Harvesting | personday | 20 | 20 | **400** |
| | Grading and Sorting | personday | 6 | 20 | **120** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **91** | **20** | **1,820** |
| **6** | Transport | trip | 4 | 500 | **2,000** |
| | | | | | |
| **7** | **Total Variable Costs** | **$** | | | **$6,910** |
| **8** | **Gross Margin/ha including Labour** | **$** | | | **$25,490** |
| **9** | **Return/Labour Inputs** | **$** | | | **$280.11** |
| **10** | **Breakeven Price/kg** | **$** | | | **$0.23** |
| **11** | **Breakeven Yield** | **kg** | | | **5,758** |
| | | | | | |
| **12** | ***Establishment Cost*** | | | | |
| | **Planting Materials** | | | | **$1,000** |
| | **Labour Cost** | | | | **$1,820** |
| | **Total** | | | | **$2,820** |

| | | | | | |
|---|---|---|---|---|---|
| | **SENSITIVITY ANALYSIS** | | | | |
| | **Cassava - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg) 0.7** | **Price($/kg) 1.2** | **Price($/kg) 1.5** |
| | 15,000 | 13,500 | 2,540 | 9,290 | 13,340 |
| | 20,000 | 18,000 | 5,690 | 14,690 | 20,090 |
| | 25,000 | 22,500 | 8,840 | 20,090 | 26,840 |
| | 30,000 | 27,000 | 11,990 | 25,490 | 33,590 |

# 9.18 Gross Margin for Dalo (Mechanised)

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | Plant Density : 16666 plants |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 1m x 0.6m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 25000 | | |
| | Production (Fresh) | kg | 25000 | | |
| | Marketable Production (90%) | kg | 22500 | | 22,500 |
| | Price/kg | $ | 1.5 | | |
| | **Gross Value of Output** | **$** | **33750** | | **33,750** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Suncloprid | ltr | 1 | 32.9 | **32.9** |
| | Paraquat | litre | 4 | 19.17 | **76.68** |
| | | | | | |
| | Planting Material | tops | 16666 | 0.15 | **2499.9** |
| | | | | | |
| | **Total Input Costs** | | | | **4615** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| **5** | **Labour Inputs** | | | | |
| | Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 20 | 20 | **400** |
| | Weed Control | personday | 20 | 20 | **400** |
| | Interow Cultivation/Hilling | personday | 45 | 20 | **900** |
| | Harvesting | personday | 20 | 20 | **400** |
| | Grading and Sorting | personday | 8 | 20 | **160** |
| | Packing | personday | 8 | 20 | **160** |
| | **Total Labour Days @ $20/personday** | | **141** | | **2,820** |
| | | | | | |
| **6** | Transport | trip | 5 | 500 | **2,500** |
| | | | | | |
| **7** | **Total Variable Costs** | **$** | | | **$10,515** |
| **8** | **Gross Margin/ha including Labour** | **$** | | | **$23,235** |
| **9** | **Return/Labour Inputs** | **$** | | | **$164.79** |
| **10** | **Breakeven Price/kg** | **$** | | | **$0.42** |
| **11** | **Breakeven Yield** | **kg** | | | **7,010** |
| | | | | | |
| **12** | ***Establishment Cost*** | | | | |
| | **Planting Materials** | | | | **$2,500** |
| | **Land Preparation** | | | | **$580** |
| | **Labour** | | | | **$2,820** |
| | **Total** | | | | **$5,900** |
| | | | | | |
| | **SENSITIVITY ANALYSIS** | | | | |
| | **Dalo - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg) 0.7** | **Price($/kg) 1.5** | **Price($/kg) 2.3** |
| | 14,000 | 12,600 | -1,695 | 8,385 | 18,465 |
| | 16,000 | 14,400 | -435 | 11,085 | 22,605 |
| | 18,000 | 16,200 | 825 | 13,785 | 26,745 |
| | 20,000 | 18,000 | 2,085 | 16,485 | 30,885 |

# 9.19 Gross Margin for Dalo (Traditional)

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated underTraditional Farming System*** | | | | Plant Density : 10000 plants |
| | ***Assumptions*** | | | | |
| **1** | Spacing | 1m x 1m | | | |
| | | | | | |
| **2** | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 20000 | | |
| | Production (Fresh) | kg | 20000 | | |
| | Marketable Production (90%) | kg | 18000 | | 18,000 |
| | Price/kg | $ | 1.5 | | |
| | **Gross Value of Output** | **$** | **27000** | | **27,000** |
| | | | | | |
| | | **Unit** | **Quantity** | **Unit Cost** | **Total Costs** |
| **3** | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 200 | 51.88/25kg | **415** |
| | Urea | kg | 100 | 76.04/40kg | **190** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Suncloprid | ltr | 1 | 32.9 | **32.9** |
| | Paraquat | litre | 4 | 19.17 | **76.68** |
| | | | | | |
| | Planting Material | tops | 10000 | 0.15 | **1500** |
| | | | | | |
| | **Total Input Costs** | | | | **3615** |
| | | | | | |
| | | | | | |
| **4** | **Labour Inputs** | | | | |
| | **Land Clearing** | personday | 20 | 20 | 400 |
| | Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 20 | 20 | **400** |
| | Weed Control | personday | 20 | 20 | **400** |
| | Harvesting | personday | 20 | 20 | **400** |
| | Grading and Sorting | personday | 8 | 20 | **160** |
| | Packing | personday | 8 | 20 | **160** |
| | **Total Labour Days @ $20/personday** | | **116** | | **2,320** |
| | | | | | |
| **5** | Transport | trip | 5 | 500 | **2,500** |
| | | | | | |
| **6** | **Total Variable Costs** | **$** | | | **$8,435** |
| **7** | **Gross Margin/ha including Labour** | **$** | | | **$18,565** |
| **8** | **Gross Margin/ha excluding Labour** | **$** | | | **$20,885** |
| **9** | **Return/Labour Inputs** | **$** | | | **$160.05** |
| **10** | **Breakeven Price/kg** | **$** | | | **$0.42** |
| **11** | **Breakeven Yield** | **kg** | | | **5,623** |
| | | | | | |
| **12** | *Establishment Costs* | | | | |
| | **Planting Materials** | | | | **$1,500** |
| | **Labour** | | | | **$2,320** |
| | **Total** | | | | **$3,820** |

| | SENSITIVITY ANALYSIS | | | | |
|---|---|---|---|---|---|
| | **Dalo - Yield (kg/ha)** | **Marketable Yield 90%** | **Price($/kg) 0.7** | **Price($/kg) 1.5** | **Price($/kg) 2.3** |
| | 14,000 | 12,600 | 385 | 10,465 | 20,545 |
| | 16,000 | 14,400 | 1,645 | 13,165 | 24,685 |
| | 18,000 | 16,200 | 2,905 | 15,865 | 28,825 |
| | 20,000 | 18,000 | 4,165 | 18,565 | 32,965 |

# 9.20 Gross Margin for Immature Ginger (Mechanised)

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | |
| | *Assumptions* | | | | |
| 1 | Spacing | 0.9m x 0.2m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 25000 | | |
| | Production (Fresh) | kg | 25000 | | |
| | Marketable Production (90%) | kg | 22500 | | 22,500 |
| | Price/kg | $ | 0.9 | | |
| | **Gross Value of Output** | **$** | **20250** | | **20,250** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 1000 | 51.88/25kg | **2,075** |
| | Urea | kg | 300 | 76.04/40kg | **570** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1,400** |
| | Atrazine | ltr | 4 | 18.03/litre | **72** |
| | Sundomil | kg | 2 | 18.6 | **37** |
| | | | | | |
| | Planting Material | kg | 7500 | 1.00 | **7,500** |
| | | | | | |
| | **Total Input Costs** | | | | **11,654.82** |
| | | | | | |
| 4 | **Machinery Inputs** | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | 120 | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Seed Treatment | personday | 4 | 20 | **80** |
| | Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 36 | 20 | **720** |
| | Hilling | personday | 24 | 20 | **480** |
| | Weed Control | personday | 10 | 20 | **200** |
| | Harvesting | personday | 30 | 20 | **600** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 10 | 20 | **200** |
| | **Total Labour Days @ $20/personday** | | **140** | | **2,880** |
| | | | | | |
| 6 | Transport | trip | 5 | 500 | **2,500** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **17,615** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$2,635** |
| 9 | **Return/Labour Inputs** | **$** | | | **$18.82** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.70** |
| 11 | **Breakeven Yield** | **kg** | | | **19,572** |
| | | | | | |
| 12 | *Establishment Cost* | | | | |
| | **Planting Material** | | | | **$7,500** |
| | **Land Preparation** | | | | **$580** |
| | **Labour** | | | | **$2,880** |
| | **Total** | | | | **$10,960** |

**SENSITIVITY ANALYSIS**

| Immature Ginger - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | |
|---|---|---|---|---|---|
| | | | 0.7 | 0.9 | 1.2 |
| 1 | 16000 | 14400 | -7,535 | -4,655 | -335 |
| 2 | 18000 | 16200 | -6,275 | -3,035 | 1,825 |
| 3 | 20000 | 18000 | -5,015 | -1,415 | 3,985 |
| 4 | 25000 | 22500 | -1,865 | 2,635 | 9,385 |



# 9.21 Gross Margin for Immature Ginger (Traditional)

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional Farming System* | | | | |
| | *Assumptions* | | | | |
| 1 | Spacing | 0.6m x 0.15m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Fresh) | kg | 25000 | | |
| | Production (Fresh) | kg | 25000 | | |
| | Marketable Production (90%) | kg | 22500 | | 22,500 |
| | Price/kg | $ | 0.9 | | |
| | **Gross Value of Output** | **$** | **20250** | | **20,250** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 1000 | 51.88/25kg | **2,075** |
| | Urea | kg | 300 | 76.04/40kg | **570** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1,400** |
| | Atrazine | ltr | 4 | 18.03/litre | **72** |
| | Sundomil | kg | 2 | 18.6 | **37** |
| | | | | | |
| | Planting Material | kg | 7500 | 1.00 | **7,500** |
| | | | | | |
| | **Total Input Costs** | | | | **11,654.82** |
| | | | | | |
| | | | | | |
| 4 | **Labour Inputs** | | | | |
| | Seed Treatment | personday | 4 | 20 | **80** |
| | Land Clearing | personday | 20 | 20 | **400** |
| | Digging | personday | 25 | 20 | **500** |
| | Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 36 | 20 | **720** |
| | Hilling | personday | 24 | 20 | **480** |
| | Weed Control | personday | 10 | 20 | **200** |
| | Harvesting | personday | 30 | 20 | **600** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 10 | 20 | **200** |
| | **Total Labour Days @ $20/personday** | | **189** | | **3,780** |
| | | | | | |
| 5 | Transport | trip | 5 | 500 | **2,500** |
| | | | | | |
| 6 | **Total Variable Costs** | **$** | | | **17,935** |
| 7 | **Gross Margin/ha including Labour** | **$** | | | **$2,315** |
| 8 | **Return/Labour Inputs** | **$** | | | **$12.25** |
| 9 | **Breakeven Price/kg** | **$** | | | **$0.72** |
| 10 | **Breakeven Yield** | **kg** | | | **19,928** |
| | | | | | |
| 11 | *Establishment Cost* | | | | |
| | **Planting Material** | | | | **$7,500** |
| | **Labour** | | | | **$3,780** |
| | **TOTAL** | | | | **$11,280** |
| | | | | | |
| | | | | | |

**SENSITIVITY ANALYSIS**

| Immature Ginger - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | |
|---|---|---|---|---|---|
| | | | 0.7 | 0.9 | 1.2 |
| 1 | 16000 | 14400 | -7,855 | -4,975 | -655 |
| 2 | 18000 | 16200 | -6,595 | -3,355 | 1,505 |
| 3 | 20000 | 18000 | -5,335 | -1,735 | 3,665 |
| 4 | 25000 | 22500 | -2,185 | 2,315 | 9,065 |

# 9.22 Gross Margin for Yam (Mechanised)

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | Plant Density : 16,670 |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 1m x 0.6m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha | kg | 25000 | | |
| | Production | kg | 25000 | | |
| | Marketable Production (90%) | kg | 22500 | | 22,500 |
| | Price/kg | $ | 1 | | |
| | **Gross Value of Output** | **$** | **22500** | | **22,500** |
| | | | | | |
| | | ***Unit*** | ***Quantity*** | ***Unit Cost*** | ***Total Costs*** |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | Super Phosphate | kg | 200 | 28.77/25kg | **230** |
| | Muriate of Potash | kg | 200 | 53.80/25kg | **430** |
| | Urea | kg | 200 | 76.04/40kg | **380** |
| | Paraquat | litre | 3 | 19.70/litre | **59.10** |
| | Atrazine | ltr | 3 | 18.03/litre | **54.09** |
| | Manzate | kg | 1 | 23.95/kg | **24.0** |
| | Benomyl | kg | 0.3 | 5.68/100g | **17.0** |
| | Diazinon | litre | 2 | 21.70/litre | **43.4** |
| | Planting Material | sett | 16,670 mini setts | 0.20/250g mini sett | **3334.0** |
| | **Total** | | | | **$4,572.34** |
| | | | | | |
| 4 | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **$580.00** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Planting | personday | 20 | 20 | **400** |
| | Fertiliser Application | personday | 16 | 20 | **320** |
| | Weed Control | personday | 25 | 20 | **500** |
| | Cutting of Stake & Trellising | personday | 40 | 20 | **800** |
| | Harvesting | personday | 40 | 20 | **800** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 10 | 20 | **200** |
| | **Total Labour Days @ $20/personday** | | **161** | | **$3,220** |
| | | | | | |
| 6 | Transport | trip | 4 | 500 | **$2,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$10,372.34** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$12,128** |
| 9 | **Return/Labour Inputs** | **$** | | | **$75** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.41** |
| 11 | **Breakeven Yield** | **$** | | | **10,372** |
| | | | | | |
| 12 | ***Establishment Costs*** | | | | |
| | **Planting Materials** | | | | **$4,572** |
| | **Land Preparation** | | | | **$580** |
| | **Labour** | | | | **$3,220** |
| | **TOTAL** | | | | **$8,372** |

**SENSITIVITY ANALYSIS**

| | Yam - Yield (kg/ha) | Marketable Yield 90% | Price($/kg) | | |
|---|---|---|---|---|---|
| | | | **0.8** | **1** | **1.2** |
| 1 | 16,000 | 14400 | 1,148 | 4,028 | 6,908 |
| 2 | 18,000 | 16200 | 2,588 | 5,828 | 9,068 |
| 3 | 20,000 | 18000 | 4,028 | 7,628 | 11,228 |
| 4 | 25,000 | 22500 | 7,628 | 12,128 | 16,628 |

# 9.23 Gross Margin for Yam (Traditional)

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Traditional Farming System*** | | | | Plant Density : 12,500 |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 1m x 0.8m | | | |
| | | | | | |
| **2** | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha | kg | 20000 | | |
| | Production | kg | 20000 | | |
| | Marketable Production (90%) | kg | 18000 | | 18,000 |
| | Price/kg | $ | 1 | | |
| | **Gross Value of Output** | **$** | **18000** | | **18,000** |
| | | | | | |
| | | ***Unit*** | ***Quantity*** | ***Unit Cost*** | ***Total Costs*** |
| **3** | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | Super Phosphate | kg | 200 | 28.77/25kg | **230** |
| | Muriate of Potash | kg | 200 | 53.80/25kg | **430** |
| | Urea | kg | 200 | 76.04/40kg | **380** |
| | Paraquat | litre | 3 | 19.70/litre | **59.10** |
| | Atrazine | ltr | 3 | 18.03/litre | **54.09** |
| | Manzate | kg | 1 | 23.95/kg | **24.0** |
| | Benomyl | kg | 0.3 | 5.68/100g | **17.0** |
| | Diazinon | litre | 2 | 21.70/litre | **43.4** |
| | | | | | |
| | Planting Material | sett | 12500 | 0.2/250g sett | **2500.0** |
| | **Total** | | | | **$3,738.34** |
| | | | | | |
| | | | | | |
| 4 | **Labour Inputs** | | | | |
| | Clearing | personday | 25 | 20 | 500 |
| | Digging & Planting | personday | 25 | 20 | **500** |
| | Fertiliser Application | personday | 12 | 20 | **240** |
| | Weed Control | personday | 25 | 20 | **500** |
| | Cutting of Stake & Trellising | personday | 30 | 20 | **600** |
| | Harvesting | personday | 40 | 20 | **800** |
| | Grading and Sorting | personday | 10 | 20 | **200** |
| | Packing | personday | 10 | 20 | **200** |
| | **Total Labour Days @ $20/personday** | | **177** | | **$3,540.00** |
| | | | | | |
| **5** | Transport | trip | 4 | 500 | **$2,000** |
| | | | | | |
| **6** | **Total Variable Costs** | **$** | | | **$9,278.34** |
| **7** | **Gross Margin/ha including Labour** | **$** | | | **$8,722** |
| **8** | **Return/Labour Inputs** | **$** | | | **$49** |
| **9** | **Breakeven Price/kg** | **$** | | | **$0.46** |
| **10** | **Breakeven Yield** | **$** | | | **9,278** |
| | | | | | |
| **11** | ***Establishment Costs*** | | | | |
| | **PlantingMaterial** | | | | **$2,500** |
| | **Labour** | | | | **$3,540** |
| | **TOTAL** | | | | **$6,040** |
| | | | | | |
| | | | | | |

**SENSITIVITY ANALYSIS**

| **Yam - Yield (kg/ha)** | | **Marketable Yield 90%** | **Price($/kg)** | | |
|---|---|---|---|---|---|
| | | | **0.8** | **1** | **1.2** |
| 1 | 16,000 | 14400 | 2,242 | 5,122 | 8,002 |
| 2 | 18,000 | 16200 | 3,682 | 6,922 | 10,162 |
| 3 | 20,000 | 18000 | 5,122 | 8,722 | 12,322 |
| 4 | 25,000 | 22500 | 8,722 | 13,222 | 17,722 |
| | | | | | |

# 9.24 Gross Margin for Yaqona

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional Farming System* | | | | | |
| 1 | Spacing - 2m x 2m | | | | Planting Density | 2500 mounds |
| | | | | | | |
| 2 | **Production & Income Schedule** | | **Year 1** | **Year 2** | **Year3** | **Total** |
| | | | | | | |
| | Area | ha | 1 | | | |
| | Yield/ha | kg | 0 | 0 | 3,000 | 3,000 |
| | Production - Waka | kg | 0 | 0 | 2,100 | |
| | - Lewena | kg | 0 | 0 | 900 | |
| | Price per kg - Waka | $ | | | 25 | |
| | Price per kg - Lewena | $ | 0 | 0 | 15 | |
| | Income - Waka | | | | 52500 | 52500 |
| | - Lewena | | | | 13500 | 13500 |
| | **Gross Value of Output** | **$** | **0** | **0** | **66,000** | **66,000** |
| | | | | | | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | NPK | $ | 415 | 0 | 0 | **415** |
| | Urea | $ | 142.58 | 0 | 0 | **143** |
| | Paraquat | $ | 58 | 58 | 58 | **173** |
| | | | | | | |
| | Planting Material | $ | 2500 | 0 | 0 | **2500** |
| | **Total Inputs Costs** | **$** | **3115** | **58** | **58** | **3230** |
| | | | | | | |
| | | | | | | |
| 4 | **Labour Inputs (person day)** | | | | | |
| | Clearing | personday | 500 | 0 | 0 | **500** |
| | Digging and Planting | personday | 500 | 0 | 0 | **500** |
| | Fertiliser Application | personday | 1000 | 0 | 0 | **1,000** |
| | Weed Control | personday | 200 | 200 | 200 | **600** |
| | Harvesting | personday | 0 | 0 | 500 | **500** |
| | Sorting/Grading | personday | 0 | 0 | 100 | **100** |
| | **Total Labour Costs @$20/day** | $ | **2200** | **200** | **800** | **3,200** |
| | ***(Total Labour - Personday)*** | | ***110*** | ***10*** | ***40*** | ***160*** |
| | | | | | | |
| | Transport | $ | 0 | 0 | 2000 | **2,000** |
| | | | | | | |
| 5 | **Total Variable Costs** | $ | **5,315** | **258** | **2,858** | **$8,430** |
| 6 | **Gross Margin/ha including Labour** | $ | | | | **$57,570** |
| 7 | **Return/Labour Inputs** | $ | | | | **$359.81** |
| 8 | **Breakeven Price/kg (Waka)** | $ | | | | **$4.01** |
| 9 | **Breakeven Yield (Waka)** | kg | | | | 337 |
| | | | | | | |
| 10 | ***Establishment Costs*** | | | | | |
| | **Planting Materials** | | | | | **$ 2,500** |
| | **Labour Inputs** | | | | | **$ 2,200** |
| | **TOTAL** | | | | | **$ 4,700** |

**SENSITIVITY ANALYSIS**

| Yaqona (Waka) - Yield (kg/ha) | | Price ($/kg) | | | |
|---|---|---|---|---|---|
| | | **20** | **25** | **30** | **35** |
| 1 | 600 | 3,570 | 6,570 | 9,570 | 12,570 |
| 2 | 1,100 | 13,570 | 6,570 | 24,570 | 30,070 |
| 3 | 1,600 | 23,570 | 31,570 | 39,570 | 47,570 |
| 4 | 2,100 | 33,570 | 44,070 | 54,570 | 65,070 |

# 9.25 Gross Margin for Maize

| | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | Plant Density : 44,444 plants |
| | *Assumptions* | | | | |
| **1** | Spacing | 0.75m x 0.3m | | | |
| | | | | | |
| **2** | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (dried grain) | kg | 3000 | | |
| | Production (Dried Grain) | kg | 3000 | | |
| | Marketable Production (90%) | kg | 2700 | | 2,700 |
| | Price/kg | $ | 4 | | |
| | **Gross Value of Output** | **$** | **10800** | | **10,800** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| **3** | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | kg | 300 | 51.88/25kg | **623** |
| | Urea | kg | 150 | 76.04/40kg | **285** |
| | Poultry Manure | kg | 10000 | 3.5/25kg | **1400** |
| | Atrazine | litre | 5 | 18.03/litre | **90** |
| | Sunthene | kg | 1 | 5.04/100grams | **50.4** |
| | | | | | |
| | Seeds | kg | 18 | 10.00 | **180** |
| | | | | | |
| | **Total Input Costs** | | | | **2628** |
| | | | | | |
| **4** | Machinery Inputs | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| **5** | **Labour Inputs** | | | | |
| | Planting | personday | 25 | 20 | **500** |
| | Fertiliser Application | personday | 12 | 20 | **240** |
| | Spraying | personday | 8 | 20 | **160** |
| | Interow Cultivation | personday | 15 | 20 | **300** |
| | Harvesting | personday | 20 | 20 | **400** |
| | Sorting and Grading | personday | 5 | 20 | **100** |
| | Packing | personday | 6 | 20 | **120** |
| | **Total Labour Days @ $20/personday** | | **91** | | **1,820** |
| | | | | | |
| **6** | Transport | trip | 1 | 500 | **500** |
| | | | | | |
| **7** | **Total Variable Costs** | **$** | | | **5,528** |
| **8** | **Gross Margin/ha including Labour** | **$** | | | **$5,272** |
| **9** | **Return/Labour Inputs** | **$** | | | **$57.93** |
| **10** | **Breakeven Price/kg** | **$** | | | **$2** |
| **11** | **Breakeven Yield** | **kg** | | | **1382** |

**SENSITIVITY ANALYSIS**

| Maize Dried Grain - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | |
|---|---|---|---|---|---|
| | | | 2 | 3 | 4 |
| 1 | 2400 | 2160 | -1,208 | 952 | 3,112 |
| 2 | 2600 | 2340 | -848 | 1,492 | 3,832 |
| 3 | 2800 | 2520 | -488 | 2,032 | 4,552 |
| 4 | 3000 | 2700 | -128 | 2,572 | 5,272 |

# 9.26 Gross Margin for Rice - Dryland

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | | |
| | *Assumptions* | | | | | |
| 1 | Spacing | 0.2m x 0.15m | | | | |
| | | | | | | |
| 2 | Production & Income Schedule | | | | Total | |
| | Area | ha | 1 | | | |
| | Yield/ha | kg | 3000 | | | |
| | Production | kg | 3000 | | | |
| | Marketable Production (90%) | kg | 2700 | | 2,700 | |
| | Price/kg | $ | 1.5 | | | |
| | **Gross Value of Output** | **$** | **4050** | | **4,050** | |
| | | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | **Fertilizer** | | | | | |
| | Super Phosphate | bag | 125 | 51.88/25kg | **259** | |
| | Muriate of Potash | bag | 125 | 53.8/25kg | **269** | |
| | Urea (Split Application) | kg | 125 | 76.04/40kg | **238** | |
| | **Weedicide** | | | | | |
| | Propal | litre | 9 | 30.52/litre | **274.7** | |
| | MCPA | litre | 3 | 21.06/litre | **63.2** | |
| | **Insecticide** | | | | | |
| | Sunthene | kg | 2 | 5.04/100g | **100.8** | |
| | Diazinon | litre | 2 | 37.58/litre | **75.2** | |
| | | | | | | |
| | Seeds | kg | 100 | 1/kg | **100** | |
| | | | | | | |
| | **Total Input Costs** | | | | **1380** | |
| | | | | | | |
| 4 | Machinery Inputs | | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** | |
| | Harrowing | hour | 5 | 40 | **200** | |
| | Ridging | hour | 2 | 40 | **80** | |
| | **Total** | | 14.5 | | **580** | |
| | | | | | | |
| 5 | **Labour Inputs** | | | | | |
| | Planting | personday | 10 | 20 | **200** | |
| | Fertiliser Application | personday | 12 | 20 | **240** | |
| | Weed Control | personday | 8 | 20 | **160** | |
| | Spraying of Insecticides | personday | 10 | 20 | **200** | |
| | Harvesting & Collection | personday | 20 | 20 | **400** | |
| | Threshing | personday | 5 | 20 | **100** | |
| | Winowing | personday | 10 | 20 | **200** | |
| | **Total Labour Days @ $20/personday** | | **75** | | **1,500** | |
| | | | | | | |
| 6 | Transport | trip | 1 | 500 | **500** | |
| | | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$3,960** | |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$90** | |
| 9 | **Return/Labour Inputs** | **$** | | | **$1.20** | |
| 10 | **Breakeven Price/kg** | **$** | | | **$1.32** | |
| 11 | **Breakeven Yield** | **$** | | | **2,640** | |

**SENSITIVITY ANALYSIS**

| Rice - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | | |
|---|---|---|---|---|---|---|
| | | | **1** | **1.3** | **1.5** | **2** |
| 1 | 1,500 | 1350 | -2,610 | -2,205 | -1,935 | -1,260 |
| 2 | 2,000 | 1800 | -2,160 | -1,035 | -1,260 | -360 |
| 3 | 2,500 | 2250 | -1,710 | -1,035 | -585 | 540 |
| 4 | 3,000 | 2700 | -1,260 | -450 | 90 | 1,440 |

# 9.27 Gross Margin for Rice - Wetland

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | | |
| | *Assumptions* | | | | | |
| 1 | Spacing | 0.75m x 0.30m | | | | |
| | | | | | | |
| 2 | Production & Income Schedule | | | | Total | |
| | Area | ha | 1 | | | |
| | Yield/ha | kg | 3000 | | | |
| | Production | kg | 3000 | | | |
| | Marketable Production (90%) | kg | 2700 | | 2,700 | |
| | Price/kg | $ | 1.5 | | | |
| | **Gross Value of Output** | **$** | **4050** | | **4,050** | |
| | | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | **Fertilizer** | | | | | |
| | Super Phosphate | bag | 125 | 51.88/25kg | **259** | |
| | Muriate of Potash | bag | 125 | 53.8/25kg | **269** | |
| | Urea (Split Application) | kg | 125 | 76.04/40kg | **238** | |
| | **Weedicide** | | | | | |
| | Atrazine | litre | 5 | 18.03/ltr | **90.2** | |
| | **Insecticide** | | | | | |
| | Sunthene | kg | 2 | 5.04/100g | **100.8** | |
| | | | | | | |
| | Seeds | kg | 80 | 1/kg | **80** | |
| | | | | | | |
| | **Total Input Costs** | | | | **1037** | |
| | | | | | | |
| 4 | Machinery Inputs | | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** | |
| | Rotovation | hour | 5 | 40 | **200** | |
| | Puddling | hour | 2 | 40 | **80** | |
| | **Total** | | 14.5 | | **580** | |
| | | | | | | |
| 5 | **Labour Inputs** | | | | | |
| | Broadcasting | personday | 3 | 20 | **60** | |
| | Fertiliser Application | personday | 12 | 20 | **240** | |
| | Weed Control | personday | 8 | 20 | **160** | |
| | Spraying of Insecticides | personday | 10 | 20 | **200** | |
| | Harvesting & Collection | personday | 20 | 20 | **400** | |
| | Threshing | personday | 5 | 20 | **100** | |
| | Winnowing | personday | 10 | 20 | **200** | |
| | **Total Labour Days @ $20/personday** | | **68** | | **1,360** | |
| | | | | | | |
| 6 | Transport | trip | 1 | 500 | **500** | |
| | | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$3,477** | |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$573** | |
| 9 | **Return/Labour Inputs** | **$** | | | **$8.43** | |
| 10 | **Breakeven Price/kg** | **$** | | | **$1.16** | |
| 11 | **Breakeven Yield** | **$** | | | **2,318** | |

**SENSITIVITY ANALYSIS**

| Rice - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | | |
|---|---|---|---|---|---|---|
| | | | 1.2 | 1.3 | 1.4 | 1.5 |
| 1 | 1,500 | 1350 | -1,857 | -1,722 | -1,587 | -1,452 |
| 2 | 2,000 | 1800 | -1,317 | -1,137 | -957 | -777 |
| 3 | 2,500 | 2250 | -777 | -552 | -327 | -102 |
| 4 | 3,000 | 2700 | -237 | 33 | 303 | 573 |

# 9.28 Gross Margin for Cowpea

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | |
| | *Assumptions* | | | | |
| 1 | Spacing | 0.65m x 0.20m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Green) | kg | 6000 | | |
| | Production | kg | 6000 | | |
| | Marketable Production (90%) | kg | 5400 | | 5,400 |
| | Price/kg | $ | 4.5 | | |
| | **Gross Value of Output** | **$** | **24300** | | **24,300** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | **Fertilizer** | | | | |
| | Blend A | kg | 100 | 60/50kg | **120** |
| | Blend B | kg | 100 | 60/50kg | **120** |
| | Bio Grow | litre | 4 | 14.31 | **57.24** |
| | Bio Harvest | litre | 4 | 14.31 | **57.24** |
| | | | | | |
| | **Fungicide** | | | | |
| | Benomyl | kg | 0.28 | 5.68/100g | **15.90** |
| | **Insecticide** | | | | |
| | Lannate | kg | 1.00 | 96.94/kg | **96.94** |
| | Bifenthrin | litre | 0.20 | 29.61/litre | **5.92** |
| | | | | | |
| | Seeds | kg | 28.00 | 1.5/kg | **42.00** |
| | | | | | |
| | **Total Input Costs** | | | | **515.25** |
| | | | | | |
| 4 | **Machinery Inputs** | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Planting | personday | 6 | 20 | **120** |
| | Fertiliser Application | personday | 12 | 20 | **240** |
| | Weed Control | personday | 6 | 20 | **120** |
| | Spraying of Pesticide | personday | 10 | 20 | **200** |
| | Harvesting | personday | 20 | 20 | **400** |
| | Sorting & Grading | personday | 5 | 20 | **100** |
| | **Total Labour Days @ $20/personday** | | **59** | | **1,180** |
| | | | | | |
| 6 | Transport | trip | 2 | 500 | **1,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$3,275** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$21,025** |
| 9 | **Return/Labour Inputs** | **$** | | | **$356.35** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.55** |
| 11 | **Breakeven Yield** | **$** | | | **728** |

**SENSITIVITY ANALYSIS**

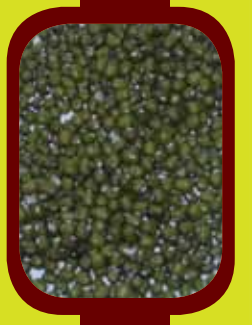
| Cowpea - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | | |
|---|---|---|---|---|---|---|
| | | | 2.5 | 3.5 | 4.5 | 5.5 |
| 1 | 3,000 | 2700 | 3,475 | 6,175 | 8,875 | 11,575 |
| 2 | 4,000 | 3600 | 5,725 | 9,325 | 12,925 | 16,525 |
| 3 | 5,000 | 4500 | 7,975 | 12,475 | 16,975 | 21,475 |
| 4 | 6,000 | 5400 | 10,225 | 15,625 | 21,025 | 26,425 |

# 9.29 Gross Margin for Mung Bean

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | |
| | *Assumptions* | | | | |
| 1 | Spacing | 0.65m x 0.20m | | | |
| | | | | | |
| 2 | Production & Income Schedule | | | | Total |
| | Area | ha | 1 | | |
| | Yield/ha (Green) | kg | 6000 | | |
| | Production | kg | 6000 | | |
| | Marketable Production (90%) | kg | 5400 | | 5,400 |
| | Price/kg | $ | 3.5 | | |
| | **Gross Value of Output** | **$** | **18900** | | **18,900** |
| | | | | | |
| | | **Unit** | **Quantity** | **Unit Cost** | **Total Costs** |
| 3 | **Direct Costs** | | | | |
| | Inputs | | | | |
| | **Fertilizer** | | | | |
| | Blend A | kg | 100 | 60/50kg | **120** |
| | Blend B | kg | 100 | 60/50kg | **120** |
| | Bio Grow | litre | 4 | 14.31 | **57.24** |
| | Bio Harvest | litre | 4 | 14.31 | **57.24** |
| | | | | | |
| | **Fungicide** | | | | |
| | Benomyl | kg | 0.28 | 5.68/100g | **15.90** |
| | **Insecticide** | | | | |
| | Lannate | kg | 1.00 | 96.94/kg | **96.94** |
| | Bifenthrin | litre | 0.20 | 29.61/litre | **5.92** |
| | | | | | |
| | Seeds | kg | 22.00 | 1.5/kg | **33.00** |
| | | | | | |
| | **Total Input Costs** | | | | **506.25** |
| | | | | | |
| 4 | **Machinery Inputs** | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** |
| | Harrowing | hour | 5 | 40 | **200** |
| | Ridging | hour | 2 | 40 | **80** |
| | **Total** | | 14.5 | | **580** |
| | | | | | |
| 5 | **Labour Inputs** | | | | |
| | Planting | personday | 6 | 20 | **120** |
| | Fertiliser Application | personday | 12 | 20 | **240** |
| | Weed Control | personday | 6 | 20 | **120** |
| | Spraying of Pesticide | personday | 10 | 20 | **200** |
| | Harvesting | personday | 20 | 20 | **400** |
| | Sorting & Grading | personday | 5 | 20 | **100** |
| | **Total Labour Days @ $20/personday** | | **59** | | **1,180** |
| | | | | | |
| 6 | Transport | trip | 2 | 500 | **1,000** |
| | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$3,266** |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$15,634** |
| 9 | **Return/Labour Inputs** | **$** | | | **$264.98** |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.54** |
| 11 | **Breakeven Yield** | **$** | | | **933** |

**SENSITIVITY ANALYSIS**

| Mung Bean - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | | |
|---|---|---|---|---|---|---|
| | | | 1.5 | 2.5 | 3.5 | 4.5 |
| 1 | 3,000 | 2700 | $784 | $3,484 | $6,184 | $8,884 |
| 2 | 4,000 | 3600 | $2,134 | $5,734 | $9,334 | $12,934 |
| 3 | 5,000 | 4500 | $3,484 | $7,984 | $12,484 | $16,984 |
| 4 | 6,000 | 5400 | $4,834 | $10,234 | $15,634 | $21,034 |


# 9.30 Gross Margin for Peanuts

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | | |
| | *Assumptions* | | | | | |
| 1 | Spacing | 0.65m x 0.20m | | | | |
| | | | | | | |
| 2 | Production & Income Schedule | | | | Total | |
| | Area | ha | 1 | | | |
| | Yield/ha (Green) | kg | 3600 | | | |
| | Production | kg | 3600 | | | |
| | Marketable Production (90%) | kg | 3240 | | 3,240 | |
| | Price/kg | $ | 4.5 | | | |
| | **Gross Value of Output** | **$** | **14580** | | **14,580** | |
| | | | | | | |
| | | **Unit** | **Quantity** | **Unit Cost** | **Total Costs** | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | **Fertilizer** | | | | | |
| | Blend A | kg | 100 | 60/50kg | **120** | |
| | Blend B | kg | 100 | 60/50kg | **120** | |
| | Bio Grow | litre | 4 | 14.31 | **57.24** | |
| | Bio Harvest | litre | 4 | 14.31 | **57.24** | |
| | | | | | | |
| | **Fungicide** | | | | | |
| | Mancozeb | kg | 0.88 | 22.33/litre | **19.65** | |
| | **Insecticide** | | | | | |
| | Suncis | litre | 0.50 | 15.83/litre | **7.92** | |
| | Steward 150SC | litre | 0.50 | 333.49/litre | **166.75** | |
| | | | | | | |
| | Seeds | kg | 115.00 | 1.5/kg | **172.50** | |
| | | | | | | |
| | **Total Input Costs** | | | | **721.29** | |
| | | | | | | |
| 4 | **Machinery Inputs** | | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** | |
| | Harrowing | hour | 5 | 40 | **200** | |
| | Ridging | hour | 2 | 40 | **80** | |
| | **Total** | | 14.5 | | **580** | |
| | | | | | | |
| 5 | **Labour Inputs** | | | | | |
| | Planting | personday | 6 | 20 | **120** | |
| | Fertiliser Application | personday | 12 | 20 | **240** | |
| | Weed Control | personday | 6 | 20 | **120** | |
| | Spraying of Pesticide | personday | 10 | 20 | **200** | |
| | Harvesting | personday | 20 | 20 | **400** | |
| | Sorting & Grading | personday | 5 | 20 | **100** | |
| | **Total Labour Days @ $20/personday** | | **59** | | **1,180** | |
| | | | | | | |
| 6 | Transport | trip | 2 | 500 | **1,000** | |
| | | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$3,481** | |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$11,099** | |
| 9 | **Return/Labour Inputs** | **$** | | | **$188.11** | |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.97** | |
| 11 | **Breakeven Yield** | **$** | | | **774** | |

**SENSITIVITY ANALYSIS**

| Peanuts - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | | |
|---|---|---|---|---|---|---|
| | | | **1.5** | **2.5** | **3.5** | **4.5** |
| 1 | 1,600 | 1440 | -$1,321 | $119 | $1,559 | $2,999 |
| 2 | 2,600 | 2340 | $29 | $2,369 | $4,709 | $7,049 |
| 3 | 3,600 | 3240 | $1,379 | $4,619 | $7,859 | $11,099 |
| 4 | 4,600 | 4140 | $2,729 | $6,869 | $11,009 | $15,149 |

# 9.32 Gross Margin for Pigeon Pea

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | | |
| | *Assumptions* | | | | | |
| 1 | Spacing | 0.65m x 0.20m | | | | |
| | | | | | | |
| 2 | Production & Income Schedule | | | | Total | |
| | Area | ha | 1 | | | |
| | Yield/ha (Green) | kg | 4000 | | | |
| | Production | kg | 4000 | | | |
| | Marketable Production (90%) | kg | 3600 | | 3,600 | |
| | Price/kg | $ | 3.5 | | | |
| | **Gross Value of Output** | **$** | **12600** | | **12,600** | |
| | | | | | | |
| | | **Unit** | **Quantity** | **Unit Cost** | **Total Costs** | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | **Fertilizer** | | | | | |
| | Blend A | kg | 100 | 60/50kg | **120** | |
| | Blend B | kg | 100 | 60/50kg | **120** | |
| | Bio Grow | litre | 4 | 14.31 | **57.24** | |
| | Bio Harvest | litre | 4 | 14.31 | **57.24** | |
| | | | | | | |
| | **Fungicide** | | | | | |
| | Mancozeb | kg | 0.88 | 22.33/litre | **19.65** | |
| | **Insecticide** | | | | | |
| | Sundothrin | litre | 0.55 | 36.20/litre | **19.91** | |
| | | | | | | |
| | Seeds | kg | 30.00 | 1.5/kg | **45.00** | |
| | | | | | | |
| | **Total Input Costs** | | | | **439.04** | |
| | | | | | | |
| 4 | **Machinery Inputs** | | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** | |
| | Harrowing | hour | 5 | 40 | **200** | |
| | Ridging | hour | 2 | 40 | **80** | |
| | **Total** | | 14.5 | | **580** | |
| | | | | | | |
| 5 | **Labour Inputs** | | | | | |
| | Planting | personday | 6 | 20 | **120** | |
| | Fertiliser Application | personday | 12 | 20 | **240** | |
| | Weed Control | personday | 6 | 20 | **120** | |
| | Spraying of Pesticide | personday | 10 | 20 | **200** | |
| | Harvesting | personday | 20 | 20 | **400** | |
| | Sorting & Grading | personday | 5 | 20 | **100** | |
| | **Total Labour Days @ $20/personday** | | **59** | | **1,180** | |
| | | | | | | |
| 6 | Transport | trip | 1 | 500 | **500** | |
| | | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$2,699** | |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$9,901** | |
| 9 | **Return/Labour Inputs** | **$** | | | **$167.81** | |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.67** | |
| 11 | **Breakeven Yield** | **$** | | | **771** | |
| | | | | | | |

**SENSITIVITY ANALYSIS**

| Pigeon Pea - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | | |
|---|---|---|---|---|---|---|
| | | | 1.5 | 2.5 | 3.5 | 4.5 |
| 1 | 1,000 | 900 | -$1,349 | -$449 | $451 | $1,351 |
| 2 | 2,000 | 1800 | $1 | $1,801 | $3,601 | $5,401 |
| 3 | 3,000 | 2700 | $1,351 | $4,051 | $6,751 | $9,451 |
| 4 | 4,000 | 3600 | $2,701 | $6,301 | $9,901 | $13,501 |

# 9.33 Gross Margin for Urd

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | | |
| | *Assumptions* | | | | | |
| 1 | Spacing | 0.65m x 0.20m | | | | |
| | | | | | | |
| 2 | Production & Income Schedule | | | | Total | |
| | Area | ha | 1 | | | |
| | Yield/ha (Green) | kg | 1800 | | | |
| | Production | kg | 1800 | | | |
| | Marketable Production (90%) | kg | 1620 | | 1,620 | |
| | Price/kg | $ | 4 | | | |
| | **Gross Value of Outpu** | **$** | **6480** | | **6,480** | |
| | | | | | | |
| | | **Unit** | **Quantity** | **Unit Cost** | **Total Costs** | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | **Fertilizer** | | | | | |
| | Blend A | kg | 100 | 60/50kg | **120** | |
| | Blend B | kg | 100 | 60/50kg | **120** | |
| | Bio Grow | litre | 4 | 14.31 | **57.24** | |
| | Bio Harvest | litre | 4 | 14.31 | **57.24** | |
| | | | | | | |
| | **Fungicide** | | | | | |
| | Benomyl | kg | 0.30 | 5.68/100 gram | **17.04** | |
| | **Insecticide** | | | | | |
| | Lannate | kg | 0.80 | 96.94/litre | **77.55** | |
| | Suncloprid | litre | 0.20 | 32.88/litre | **6.58** | |
| | Seeds | kg | 17.00 | 1.5/kg | **25.50** | |
| | | | | | | |
| | **Total Input Costs** | | | | **481.15** | |
| | | | | | | |
| 4 | **Machinery Inputs** | | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** | |
| | Harrowing | hour | 5 | 40 | **200** | |
| | Ridging | hour | 2 | 40 | **80** | |
| | **Total** | | 14.5 | | **580** | |
| | | | | | | |
| 5 | **Labour Inputs** | | | | | |
| | Planting | personday | 6 | 20 | **120** | |
| | Fertiliser Application | personday | 12 | 20 | **240** | |
| | Weed Control | personday | 6 | 20 | **120** | |
| | Spraying of Pesticide | personday | 10 | 20 | **200** | |
| | Harvesting | personday | 20 | 20 | **400** | |
| | Sorting & Grading | personday | 5 | 20 | **100** | |
| | **Total Labour Days @ $20/personday** | | **59** | | **1,180** | |
| | | | | | | |
| 6 | Transport | trip | 1 | 500 | **500** | |
| | | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$2,741** | |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$3,739** | |
| 9 | **Return/Labour Inputs** | **$** | | | **$63.37** | |
| 10 | **Breakeven Price/kg** | **$** | | | **$1.52** | |
| 11 | **Breakeven Yield** | **$** | | | **685** | |

**SENSITIVITY ANALYSIS**

| **Pigeon Pea - Yield (kg/ha)** | | **Marketable Yield** | **Price($/kg)** | | | |
|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** |
| 1 | 1,200 | 1080 | -$1,661 | -$581 | $499 | $1,579 |
| 2 | 1,400 | 1260 | -$1,481 | -$221 | $1,039 | $2,299 |
| 3 | 1,600 | 1440 | -$1,301 | $139 | $1,579 | $3,019 |
| 4 | 1,800 | 1620 | -$1,121 | $499 | $2,119 | $3,739 |

# 9.34 Gross Margin for Passionfruit

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | | |
| 1 | Spacing - 3m x 3m | | | | Planting Density | 1111 plants |
| | | | | | | |
| 2 | Production & Income Schedule | | Year 1 | Year 2 | Year3 | |
| | | | | | | |
| | Area | ha | 1 | | | |
| | Yield/ha | kg | 12,000 | 20,000 | 10,000 | |
| | Production | kg | 12,000 | 20,000 | 10,000 | |
| | Marketable Production (90%) | kg | 10,800 | 18,000 | 9,000 | |
| | Price/kg | $ | 1.5 | 1.5 | 1.5 | |
| | **Gross Value of Output** | **$** | **16200** | **27000** | **13500** | **56,700** |
| | | | | | | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | NPK | $ | 2324 | 691 | 691 | **3706** |
| | Glyphosate | $ | 43 | 43 | 43 | **128** |
| | Benomyl | $ | 17.04 | 17.04 | 17.04 | **51** |
| | Rogor | $ | 13.11 | 13.11 | 13.11 | **39** |
| | | | | | | |
| | | | | | | |
| | Seedlings @$1 | $ | 1111 | 0 | 0 | **1111** |
| | **Total Inputs Costs** | | **3508** | **764** | **764** | **5036** |
| | | | | | | |
| | **Machinery Inputs** | | | | | |
| | Ploughing | $ | 300 | 0 | 0 | **300** |
| | Harrowing | $ | 200 | 0 | 0 | **200** |
| | Ridging | $ | 80 | 0 | 0 | **80** |
| | **Sub Total** | | **580** | 0 | 0 | **580** |
| | | | | | | |
| 4 | **Labour Inputs (person day)** | | | | | |
| | Sowing of Seedlings in Polythene bags | personday | 2 | 0 | 0 | **2** |
| | Planting | personday | 15 | 0 | 0 | **15** |
| | Fertiliser Application | personday | 35 | 24 | 24 | **83** |
| | Spraying | personday | 15 | 10 | 10 | **35** |
| | Weeding | personday | 20 | 20 | 20 | **60** |
| | Trellesing | personday | 15 | 0 | 0 | **15** |
| | Harvesting | personday | 15 | 20 | 20 | **55** |
| | Sorting/Grading | personday | 10 | 20 | 10 | **40** |
| | Total Labour Days | | 127 | 94 | 84 | **305** |
| | **Total Labour Costs @$20/day** | $ | **2540** | **1880** | **1680** | **6,100** |
| | | | | | | |
| | Transport | $ | 3750 | 2500 | 1250 | **7,500** |
| | | | | | | |
| **5** | **Total Variable Costs** | $ | **10,378** | **5,144** | **3,694** | **$19,216** |
| **6** | **Gross Margin/ha including Labour** | $ | **5,822** | **21,856** | **9,806** | **$37,484** |
| **7** | **Return/Labour Inputs** | $ | 45.84 | 232.51 | 116.74 | |
| **8** | **Breakeven Price/kg** | $ | 0.86 | 0.26 | 0.37 | |
| **9** | **Breakeven Yield** | kg | **6918.6** | **3429.3** | **2462.6** | |
| | | | | | | |
| **10** | **Establishment Cost** | | | | | |
| | **Planting Materials** | | | | | **$1,111** |
| | **Land Preparation** | | | | | **$580** |
| | **Labour** | | | | | **$2,540** |
| | **Trellising** | | | | | **$1,500** |
| | **TOTAL** | | | | | **$5,731** |

| **Passionfruit - Yield (kg/ha)** | | **Marketable Yield 90%** | **Price($/kg)** | | |
|---|---|---|---|---|---|
| | | | 1 | 1.5 | 2 |
| 1 | 8,000 | 7200 | -3,178 | 422 | 4,022 |
| 2 | 10,000 | 9000 | -1,378 | 3,122 | 7,622 |
| 3 | 12,000 | 10800 | 422 | 5,822 | 11,222 |
| 4 | 14,000 | 12600 | 2,222 | 8,522 | 14,822 |

# 9.35 Gross Margin for Pineapple

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional Farming System - Slopy Land* | | | | | |
| 1 | *Spacing - 1.2m between ridges, 0.6m between rows/ridge & 0.3m between plants* | | | | Planting Density | 37,037 plants |
| | | | | | | |
| 2 | **Production & Income Schedule** | | **Year 1** | **Year 2** | **Year 3** | |
| | | | | | | |
| | Area | ha | 1 | | | |
| | Yield/ha | kg | 40,000 | 30,000 | 20,000 | |
| | Production | kg | 40,000 | 30,000 | 20,000 | |
| | Marketable Production (90%) | kg | 36,000 | 27,000 | 18,000 | |
| | Price/kg | $ | 1 | 1 | 1 | |
| | **Gross Value of Output** | **$** | **36000** | **27000** | **18000** | |
| | | | | | | |
| 2 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | Super Phosphate | $ | 288 | 0 | 0 | **288** |
| | Urea | $ | 279 | 76 | 76 | **431** |
| | NPK | $ | 1556.40 | 1556.40 | 1556.40 | **4669.20** |
| | Eithrel | $ | 100.00 | 100.00 | 100.00 | **300.00** |
| | Borax | $ | 88.92 | 88.92 | 88.92 | **266.76** |
| | Diuron | $ | 104.04 | 104.04 | 104.04 | **312.12** |
| | Mancozeb | $ | 13.40 | 13.40 | 13.40 | **40.19** |
| | Bifenthrine | $ | 14.81 | 14.81 | 14.81 | **44.42** |
| | | | | | | |
| | Suckers @$0.20 | $ | 7407.40 | 0 | 0 | **7407.40** |
| | **Total Inputs Costs** | | **9851.66** | **1953.60** | **1953.60** | **13759** |
| | | | | | | |
| | | | | | | |
| 4 | **Labour Inputs (person day)** | | | | | |
| | Land Clearing | personday | 20 | 0 | 0 | **20** |
| | Planting | personday | 25 | 0 | 0 | **25** |
| | Fertiliser Application | personday | 24 | 12 | 12 | **48** |
| | Spraying | personday | 25 | 20 | 20 | **65** |
| | Weeding | personday | 20 | 20 | 20 | **60** |
| | Harvesting | personday | 15 | 20 | 20 | **55** |
| | Sorting/Grading | personday | 10 | 20 | 10 | **40** |
| | Total Labour Days | | 139 | 92 | 82 | **313** |
| | **Total Labour Costs @$20/day** | $ | **2780** | **1840** | **1640** | **6260** |
| | | | | | | |
| | Transport | $ | **4000** | **3000** | **2000** | **9,000** |
| | | | | | | |
| 5 | **Total Variable Costs** | $ | **16,632** | **6,794** | **5,594** | **$29,019** |
| 6 | **Gross Margin/ha including Labour** | $ | **$19,368** | **$20,206** | **$12,406** | **$51,981** |
| 7 | **Return/Labour Inputs** | $ | 139.34 | 219.63 | 151.30 | |
| 8 | **Breakeven Price/kg** | $ | $0.42 | $0.23 | $0.28 | |
| 9 | **Breakeven Yield** | kg | **16,632** | **6,794** | **5,594** | |
| | | | | | | |
| 10 | *Establishment Cost* | | | | | |
| | **Planting Material** | | | | | **$7,407.40** |
| | **Labour** | | | | | **$2,780.00** |
| | | | | | | **$10,187.40** |

| Pineapple - Yield (kg/ha) | | Marketable Yield 90% | Price($/kg) | | |
|---|---|---|---|---|---|
| | | | 1 | 1.5 | 2 |
| 1 | 20,000 | 18000 | 1,368 | 10,368 | 30,406 |
| 2 | 30,000 | 27000 | 10,368 | 23,868 | 48,406 |
| 3 | 35,000 | 31500 | 14,868 | 30,618 | 57,406 |
| 4 | 40,000 | 36000 | 19,368 | 37,368 | 66,406 |

# 9.36 Gross Margin for Watermelon

| | | | | | | |
|---|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Mechanised Farming System*** | | | | | |
| | *Assumptions* | | | | | |
| 1 | Spacing | 3m x 1m | | | | |
| | | | | | | |
| 2 | ***Production & Income Schedule*** | | | | Total | |
| | Area | ha | 1 | | | |
| | Yield/ha (Green) | kg | 20,000 | | | |
| | Production | kg | 20,000 | | | |
| | Marketable Production (90%) | kg | 18,000 | | 18,000 | |
| | Price/kg | $ | 1 | | | |
| | ***Gross Value of Output*** | **$** | **18000** | | **18,000** | |
| | | | | | | |
| | | **Unit** | **Quantity** | **Unit Cost** | **Total Costs** | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | **Fertilizer** | | | | | |
| | Poultry Manure | kg | 10,000 | 3.5/25kg | **1400** | |
| | NPK | kg | 200 | 51.88/25kg | **415.04** | |
| | Urea | kg | 100 | 76.04/40kg | **190.10** | |
| | **Fungicide** | | | | | |
| | Kocide | kg | 0.80 | 35.65/500g | **57.04** | |
| | **Insecticide** | | | | | |
| | Suncloprid | litre | 0.40 | 32.88/litre | **13.15** | |
| | Bifenthrine | litre | 0.50 | 29.61/litre | **14.81** | |
| | | | | | | |
| | Seeds | kg | 2.00 | 5.5/10g | **1100.00** | |
| | | | | | | |
| | **Total Input Costs** | | | | **3190.14** | |
| | | | | | | |
| 4 | **Machinery Inputs** | | | | | |
| | Ploughing | hour | 7.5 | 40 | **300** | |
| | Harrowing | hour | 5 | 40 | **200** | |
| | Ridging | hour | 2 | 40 | **80** | |
| | **Total** | | 14.5 | | **580** | |
| | | | | | | |
| 5 | **Labour Inputs** | | | | | |
| | Planting | personday | 18 | 20 | **360** | |
| | Fertiliser Application | personday | 12 | 20 | **240** | |
| | Weed Control | personday | 10 | 20 | **200** | |
| | Spraying of Pesticide | personday | 10 | 20 | **200** | |
| | Harvesting | personday | 20 | 20 | **400** | |
| | Sorting & Grading | personday | 5 | 20 | **100** | |
| | **Total Labour Days @ $20/personday** | | **75** | | **1,500** | |
| | | | | | | |
| 6 | Transport | trip | 4 | 500 | **2,000** | |
| | | | | | | |
| 7 | **Total Variable Costs** | **$** | | | **$7,270** | |
| 8 | **Gross Margin/ha including Labour** | **$** | | | **$10,730** | |
| 9 | **Return/Labour Inputs** | **$** | | | **$143.06** | |
| 10 | **Breakeven Price/kg** | **$** | | | **$0.36** | |
| 11 | **Breakeven Yield** | **$** | | | **7,270** | |
| | | | | | | |
| 12 | *Establishment Costs* | | | | | |
| | **Seeds** | | | | **$1,100** | |
| | **Land Preparation** | | | | **$580** | |
| | **Labour** | | | | **$1,500** | |
| | **Total** | | | | **$3,180** | |

**SENSITIVITY ANALYSIS**

| | Watermelon - Yield (kg/ha) | Marketable Yield 90% | Price($/kg) 0.5 | 1 | 1.2 | 1.5 |
|---|---|---|---|---|---|---|
| 1 | 14,000 | 12600 | -$970 | $5,330 | $7,850 | $11,630 |
| 2 | 16,000 | 14400 | -$70 | $7,130 | $10,010 | $14,330 |
| 3 | 18,000 | 16200 | $830 | $8,930 | $12,170 | $17,030 |
| 4 | 20,000 | 18000 | $1,730 | $10,730 | $14,330 | $19,730 |

# 9.37 Gross Margin for Banana

| | | | | | |
|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional Farming System* | | | | |
| 1 | Spacing - 3m x 3m | | | | 1111 plants |
| | | | | | |
| 2 | ***Production & Income Schedule*** | | **Year 1** | **Year 2** | |
| | | | | | |
| | Area | ha | 1 | | |
| | Yield/ha | bunches | 1,666 | 2,500 | |
| | Production | bunches | 1,666 | 2,500 | |
| | Production | kg | 24,990 | 37,500 | |
| | Marketable Production (90%) | kg | 22,491 | 33,750 | |
| | Price/kg | $ | 1.5 | 1.5 | 1.5 |
| | **Gross Value of Output** | **$** | **33,737** | **50,625** | **84,362** |
| | | | | | |
| | **Direct Costs** | | | | |
| | Inputs | | | | |
| | NPK | $ | 2324 | 691 | **3015** |
| | Glyphosate | $ | 43 | 43 | **86** |
| | Benomyl | $ | 17.04 | 17.04 | **34.08** |
| | Rogor | $ | 13.11 | 13.11 | **26.22** |
| | | | | | |
| | Seedlings @$1 | $ | 1111 | 0 | **1111** |
| | **Total Inputs Costs** | | **3508** | **764** | **4272** |
| | | | | | |
| | | | | | |
| 3 | **Labour Inputs (person day)** | | | | |
| | Clearing & Planting | personday | 15 | 0 | **15** |
| | Fertiliser Application | personday | 16 | 12 | **28** |
| | Spraying | personday | 10 | 10 | **20** |
| | Weeding | personday | 20 | 15 | **35** |
| | Harvesting | personday | 15 | 20 | **35** |
| | Sorting/Grading | personday | 10 | 20 | **30** |
| | Total Labour Days | | 86 | 77 | **163** |
| | **Total Labour Costs @$20/day** | $ | **1720** | **1540** | **3,260** |
| | | | | | |
| 4 | Transport | $ | 3750 | 312.5 | **4,063** |
| | | | | | |
| 5 | **Total Variable Costs** | $ | **8,978** | **2,616** | **$11,594** |
| 6 | **Gross Margin/ha including Labour** | $ | **$24,759** | **$48,009** | **$72,767** |
| 7 | **Return/Labour Inputs** | $ | **287.89** | **623.49** | **$911.38** |
| 8 | **Breakeven Price/kg** | $ | **0.36** | **0.07** | |
| 9 | **Breakeven Yield** | kg | **5985.3** | **1744.3** | |
| | | | | | |
| 10 | **Establishment Cost** | | | | |
| | **Planting Material** | | | | **$1,111** |
| | **Labour** | | | | **$1,720** |
| | **TOTAL** | | | | **$2,831** |

| **Banana - Yield (kg/ha)** | | **Marketable Yield 90%** | **Price($/kg)** | |
|---|---|---|---|---|
| | | | 0.8 | 1.5 |
| 1 | 10,990 | 9891 | -1,065 | 5,859 |
| 2 | 15,990 | 14391 | 2,535 | 12,609 |
| 3 | 20,990 | 18891 | 6,135 | 19,359 |
| 4 | 24,990 | 22491 | 9,015 | 24,759 |
| | | | | |

# 9.37 Gross Margin for Cocoa

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional Farming System* | | | | | | | |
| 1 | Spacing - 2m x 2m | | | | Planting Density | 2500 plants | | |
| | | | | | | | | |
| 2 | Production & Income Schedule | | Year 1 | Year 2 | Year3 | Year 4 | Year 5 | Total |
| | | | | | | | | |
| | Area | ha | 1 | | | | | |
| | Yield/ha (Wet) | kg | 0 | 0 | 0 | 0 | 2500 | 2,500 |
| | (Dry) | kg | | | | | 2000 | 2,000 |
| | Production (Wet) | kg | 0 | 0 | 0 | 0 | 2500 | 2,500 |
| | (Dry) | kg | | | | | 2000 | 2,000 |
| | Price/kg | $ | 0 | 0 | 0 | 0 | 6 | 6 |
| | **Gross Value of Output** | **$** | **0** | **0** | **0** | **0** | **12,000** | **12,000** |
| | | | | | | | | |
| | **Direct Costs** | | | | | | | |
| | Inputs | | | | | | | |
| | Super Phosphate | $ | 29 | 0 | 0 | 0 | 0 | 29 |
| | NPK | $ | 415 | 0 | 0 | 0 | 0 | 415 |
| | Paraquat | $ | 59 | 59 | 59 | 59 | 59 | 294 |
| | Glyphosate | $ | 43 | 0 | 0 | 0 | 0 | 43 |
| | | | | | | | | |
| | | | | | | | | |
| | Cocoa Seedlings | | | | | | | |
| | Plants @$0.30 | $ | 750 | 0 | 0 | 0 | 0 | 750 |
| | **Total Inputs Costs** | | **1295** | **59** | **59** | **59** | **59** | **1530** |
| | | | | | | | | |
| | | | | | | | | |
| 3 | **Labour Inputs (person day)** | | | | | | | |
| | Clearing | personday | 15 | 0 | 0 | 0 | 0 | 15 |
| | Planting | personday | 10 | 0 | 0 | 0 | 0 | 10 |
| | Fertiliser Application | personday | 12 | 0 | 0 | 0 | 0 | 12 |
| | Spraying & Weed Control | personday | 4 | 4 | 4 | 4 | 4 | 20 |
| | Harvesting | personday | 0 | 0 | 0 | 0 | 10 | 10 |
| | Breaking of Cocoa Pods | personday | 0 | 0 | 0 | 0 | 20 | 20 |
| | Sundrying | personday | 0 | 0 | 0 | 0 | 8 | 8 |
| | Sorting and Packing | personday | 0 | 0 | 0 | 0 | 3 | 3 |
| | Total Labour Days | | 41 | 4 | 4 | 4 | 45 | 98 |
| | **Total Labour Costs @$20/day** | $ | **820** | **80** | **80** | **80** | **900** | **1960** |
| | | | | | | | | |
| 4 | Transport | $ | 200 | 0 | 0 | 0 | 500 | 700 |
| | | | | | | | | |
| 5 | **Total Variable Costs** | $ | **2,315** | **139** | **139** | **139** | **1,459** | **4,190** |
| 6 | **Gross Margin/ha including Labour** | $ | **-2,315** | **-139** | **-139** | **-139** | **10,541** | **7,810** |
| 7 | **Return/Labour Inputs** | $ | -2.82 | -1.73 | -1.73 | -1.73 | 11.71 | 3.98 |
| 8 | **Breakeven Price/kg (Dry Bean)** | $ | | | | | | **2** |
| 9 | **Breakeven Yield** | kg | | | | | | **698.40** |
| | | | | | | | | |
| 10 | **Establishment Cost** | | | | | | | |
| | **Seedlings** | | | | | | | **$750** |
| | **Labour** | | | | | | | **$1,960** |
| | **TOTAL** | | | | | | | **$2,710** |

| Cocoa - Yield (kg/ha) | | Price($/kg) | | |
|---|---|---|---|---|
| | | **3** | **4.5** | **6.2** |
| 1 | 1400 | 10 | 2,110 | 4,490 |
| 2 | 1600 | 610 | 3,010 | 5,730 |
| 3 | 1800 | 1,210 | 3,910 | 6,970 |
| 4 | 2000 | 1,810 | 4,810 | 8,210 |

# 9.38 Gross Margin for Coconut Wholenut Processing

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional Farming System* | | | | | | | |
| 1 | Spacing - Triangular : 9m x 9m | | | | Planting Density | 123 plants | | |
| | | | | | | | | |
| | | | | | | | | |
| 2 | **Production & Income Schedule** | | **Year 1** | **Year 2** | **Year3** | **Year 4** | **Year 5** | **Total** |
| | | | | | | | | |
| | Area | ha | 1 | | | | | |
| | Total Number of Wholenut | | 0 | 0 | 0 | 0 | 6000 | 6000 |
| | | | | | | | | |
| | ***Production*** | | | | | | | |
| | Virgin Coconut Oil | litres | 0 | 0 | 0 | 0 | 404 | 404 |
| | Coconut Oil | litres | 0 | 0 | 0 | 0 | 101 | 101 |
| | Coconut Meal | kg | 0 | 0 | 0 | 0 | 496 | 496 |
| | Coconut Husk | kg | 0 | 0 | 0 | 0 | 3813 | 3,813 |
| | | | | | | | | |
| | ***Unit Price $*** | | | | | | | |
| | Virgin Coconut Oil | $ | 0 | 0 | 0 | 0 | 20/litre | |
| | Coconut Oil | $ | 0 | 0 | 0 | 0 | 7/litre | |
| | Coconut Meal | $ | 0 | 0 | 0 | 0 | 0.80/litre | |
| | Coconut Husk | $ | 0 | 0 | 0 | 0 | 1/kg | |
| | | **$** | | | | | | |
| | ***Income*** | | | | | | | |
| | Sales of VCO | **$** | **0** | **0** | **0** | **0** | **8,080** | **8,080** |
| | Sales of Coconut Oil | **$** | **0** | **0** | **0** | **0** | **707** | **707** |
| | Sales of Coconut Meal | **$** | **0** | **0** | **0** | **0** | **397** | **397** |
| | Sales of Coconut Husk | **$** | **0** | **0** | **0** | **0** | **3,813** | **3,813** |
| | **Total Income** | **$** | **0** | **0** | **0** | **0** | **12997** | **12,997** |
| | | | | | | | | |
| | **Direct Costs** | | | | | | | |
| | ***Inputs*** | | | | | | | |
| | Ammonium Sulphate | $ | 111 | 222 | 333 | 333 | 0 | **1000** |
| | Triple Superphosphate | $ | 28 | 58 | 85 | 113.61 | 0 | **284** |
| | Muriate of Potash | $ | 105 | 211 | 319 | 319 | 319 | **1273** |
| | Glyphosate | $ | 43 | 43 | 43 | 43 | 43 | **214** |
| | | | | | | | | |
| | Coconut Seedling @ 0.36 each | $ | 44 | 0 | 0 | 0 | 0 | 44 |
| | **Total Inputs Costs** | **$** | **331** | **534** | **781** | **809** | **362** | 2816 |
| | | | | | | | | |
| 3 | **Labour Inputs (person day)** | | | | | | | |
| | Clearing | personday | 15 | 0 | 0 | 0 | 0 | 15 |
| | Planting | personday | 6 | 0 | 0 | 0 | 0 | 6 |
| | Fertiliser Application | personday | 12 | 6 | 6 | 6 | 3 | 33 |
| | Spraying & Weed Control | personday | 4 | 4 | 4 | 4 | 4 | 20 |
| | Collecting Nuts | personday | 0 | 0 | 0 | 0 | 20 | 20 |
| | Husking | personday | 0 | 0 | 0 | 0 | 19 | 19 |
| | Scraping | personday | 0 | 0 | 0 | 0 | 6 | 6 |
| | Deshelling | personday | 0 | 0 | 0 | 0 | 5 | 5 |
| | Shredding of Coconuts | personday | 0 | 0 | 0 | 0 | 8 | 8 |
| | Expelling | personday | 0 | 0 | 0 | 0 | 9 | 9 |
| | Fermentation | personday | 0 | 0 | 0 | 0 | 3 | 3 |
| | Harvesting | personday | 0 | 0 | 0 | 0 | 3 | 3 |
| | Filtering | personday | 0 | 0 | 0 | 0 | 40 | 40 |
| | Sun Drying | personday | 0 | 0 | 0 | 0 | 60 | 60 |
| | Cooking of Curd | personday | 0 | 0 | 0 | 0 | 50 | 50 |
| | Drying Coconut Meal | personday | 0 | 0 | 0 | 0 | 6 | 6 |
| | Packing/Bottling | personday | 0 | 0 | 0 | 0 | 8 | 8 |
| | Labelling | personday | 0 | 0 | 0 | 0 | 2 | 2 |
| | Total Labour Inputs | personday | ***37*** | ***10*** | ***10*** | ***10*** | ***246*** | 313 |
| | **Total Labour Costs @ $20/md** | **$** | **740** | **200** | **200** | **200** | **4920** | **6260** |
| | | | | | | | | |
| 4 | Transport Costs | $ | 250 | 0 | 0 | 0 | 1000 | 1250 |
| | | | | | | | | |
| 5 | **Total Variable Costs** | **$** | **1,321** | **734** | **981** | **1,009** | **6,282** | **10,326** |
| 6 | **Gross Margin/ha including Labour** | **$** | **-1,321** | **-734** | **-981** | **-1,009** | **6,715** | **2,671** |
| 7 | **Breakeven Price/litre - VCO** | **$** | | | | | | **16** |
| | | | | | | | | |
| 8 | ***Establishment Costs*** | | | | | | | |
| | ***Planting Materials*** | | | | | | | **$44** |
| | ***Labour*** | | | | | | | **$6,260** |
| | ***TOTAL*** | | | | | | | **$6,304** |
| | | | | | | | | |

# 9.39 Gross Margin for Coconut - Copra Equivalent

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional Farming System* | | | | | | | |
| 1 | Spacing - Triangular : 9m x 9m | | | | Planting Density | 123 plants | | |
| | | | | | | | | |
| | | | | | | | | |
| 2 | **Production & Income Schedule** | | **Year 1** | **Year 2** | **Year3** | **Year 4** | **Year 5** | **Total** |
| | | | | | | | | |
| | Area | ha | 1 | | | | | |
| | Total Number of Wholenut | | 0 | 0 | 0 | 0 | 6000 | 6000 |
| | | | | | | | | |
| | ***Production*** | | | | | | | |
| | Copra Equivalent | ton | 0 | 0 | 0 | 0 | 1.2 | 1 |
| | ***Unit Price $*** | | | | | | | |
| | Copra Equivalent | $ | 0 | 0 | 0 | 0 | 900/ton | |
| | ***Income*** | | | | | | | |
| | Sales of Copra | **$** | **0** | **0** | **0** | **0** | **1,080** | **1,080** |
| | **Total Income** | **$** | **0** | **0** | **0** | **0** | **1080** | **1,080** |
| | | | | | | | | |
| | **Direct Costs** | | | | | | | |
| | ***Inputs*** | | | | | | | |
| | Ammonium Sulphate | $ | 111 | 222 | 333 | 333 | 0 | **1000** |
| | Triple Superphosphate | $ | 28 | 58 | 85 | 113.61 | 0 | **284** |
| | Muriate of Potash | $ | 105 | 211 | 319 | 319 | 319 | **1273** |
| | Glyphosate | $ | 43 | 43 | 43 | 43 | 43 | **214** |
| | | | | | | | | |
| | Coconut Seedling @ 0.36 each | $ | 44 | 0 | 0 | 0 | 0 | 44 |
| | **Total Inputs Costs** | **$** | **331** | **534** | **781** | **809** | **362** | 2816 |
| | | | | | | | | |
| 3 | **Labour Inputs (person day)** | | | | | | | |
| | Clearing | personday | 10 | 0 | 0 | 0 | 0 | 10 |
| | Planting | personday | 6 | 0 | 0 | 0 | 0 | 6 |
| | Fertiliser Application | personday | 12 | 6 | 6 | 6 | 3 | 33 |
| | Spraying & Weed Control | personday | 4 | 4 | 4 | 4 | 4 | 20 |
| | Collecting Nuts | personday | 0 | 0 | 0 | 0 | 10 | 10 |
| | Cutting of Coconut & Deflesh | personday | 0 | 0 | 0 | 0 | 10 | 10 |
| | Total Labour Inputs | personday | ***32*** | ***10*** | ***10*** | ***10*** | ***27*** | 89 |
| | **Total Labour Costs @ $20/md** | **$** | **640** | **200** | **200** | **200** | **540** | **1780** |
| | | | | | | | | |
| 4 | Transport Costs | $ | 250 | 0 | 0 | 0 | 500 | 750 |
| | | | | | | | | |
| 5 | **Total Variable Costs** | **$** | **1,221** | **734** | **981** | **1,009** | **1,402** | **5,346** |
| 6 | **Gross Margin/ha including Labour** | **$** | | | | | **-322** | |
| 7 | **Return/Labour Inputs** | **$** | | | | | | **0.00** |
| 8 | **Breakeven Price/litre - VCO** | **$** | | | | | | **0** |
| | | | | | | | | |
| 9 | **Establishment Cost** | | | | | | | |
| | Planting Material | | | | | | | $44 |
| | Labour | | | | | | | $1,780 |
| | **TOTAL** | | | | | | | **$1,824** |

# 9.40 Gross Margin for Mango

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional Farming System* | | | | | | | | | |
| 1 | Spacing : 9m x 9m | | | | Planting Density | 125 plants | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 2 | **Production & Income Schedule** | | Year 1 | Year 2 | Year3 | Year 4 | Year 5 | Year 6 | Year 7 | **Total** |
| | | | | | | | | | | |
| | Area | ha | 1 | | | | | | | |
| | Yield/ha | kg | 0 | 0 | 0 | 0 | 9840 | 9,840 | 18450 | |
| | Production | kg | 0 | 0 | 0 | 0 | 9840 | 9,840 | 18450 | |
| | Marketable Production 90% | kg | 0 | 0 | 0 | 0 | 8,856 | 8,856 | 16,605 | |
| | Price/kg | $ | 0 | 0 | 0 | 0 | 4 | 4 | 4 | |
| | **Income** | **$** | **0** | **0** | **0** | **0** | **35,424** | **35,424** | **66,420** | |
| | | | | | | | | | | |
| 3 | **Inputs** | | | | | | | | | |
| | NPK | **$** | 156 | 127.62 | 127.62 | 765.75 | 765.75 | 765.75 | 765.75 | 3474 |
| | Paraquat | **$** | 76.68 | 76.68 | 76.68 | 76.68 | 76.68 | 76.68 | 76.68 | 536.76 |
| | Benomyl | **$** | 62.48 | 62.48 | 62.48 | 62.48 | 62.48 | 62.48 | 62.48 | 374.88 |
| | | | | | | | | | | |
| | Seedlings | **$** | 123 | 0 | 0 | 0 | 0 | 0 | 0 | 123 |
| | Total Input Costs | **$** | **418** | **267** | **267** | **905** | **905** | **905** | **905** | 4571 |
| | | | | | | | | | | |
| 4 | **Labour Inputs** | | | | | | | | | |
| | Clearing | personday | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| | Planting | personday | 10 | 0 | 0 | 0 | 0 | 0 | | 10 |
| | Fertiliser Application | personday | 12 | 4 | 4 | 4 | 4 | 4 | 4 | 36 |
| | Spraying & Weed Control | personday | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 28 |
| | Harvesting | personday | 0 | 0 | 0 | 0 | 20 | 20 | 20 | 60 |
| | Sorting & Grading | personday | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 15 |
| | Packing | personday | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 15 |
| | Total | personday | 41 | 8 | 8 | 8 | 38 | 38 | 38 | 179 |
| | Total Labour Costs @ $20/md | **$** | **820** | **160** | **160** | **160** | **760** | **760** | **760** | **3580** |
| | | | | | | | | | | |
| 5 | Transport Costs | $ | 250 | 250 | 250 | 250 | 1000 | 2000 | 2000 | 2000 |
| | | | | | | | | | | |
| 6 | **Total Variable Costs** | **$** | **1,488** | **677** | **677** | **1,315** | **2,665** | **3,665** | **3,665** | **14,151** |
| 7 | **Gross Margin/ha including Labour** | **$** | **-1,488** | **-677** | **-677** | **-1,315** | **32,759** | **31,759** | **62,755** | **123,117** |
| 8 | **Return/Labour Inputs** | **$** | | | | | | | | **688** |
| 9 | **Breakeven Price/kg** | **$** | | | | | **$0.27** | **$0.37** | **$0.20** | |
| | | | | | | | | | | |
| 10 | ***Establishment Cost*** | | | | | | | | | |
| | **Planting Material** | | | | | | | | | **$123** |
| | **Labour Cost** | | | | | | | | | **$3,580** |
| | **TOTAL** | | | | | | | | | **$3,703** |
| | | | | | | | | | | |
| | | | | | | | | | | |

# 9.41 Gross Margin for Pawpaw

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised Farming System* | | | | | |
| 1 | Spacing - 3m x 2m | | | | Planting Density | 1667 plants |
| | | | | | | |
| 2 | Production & Income Schedule | | Year 1 | Year 2 | Year 3 | Total |
| | | | | | | |
| | Area | ha | 1 | | | |
| | Yield/ha | kg | 30,000 | 40,000 | 30,000 | |
| | Production | kg | 30,000 | 40,000 | 30,000 | |
| | Marketable Production (90%) | kg | 27,000 | 36,000 | 27,000 | |
| | Price/ton | $ | 2 | 2 | 2 | |
| | **Gross Value of Output** | **$** | **54000** | **72000** | **54000** | **180,000** |
| | | | | | | |
| 3 | **Direct Costs** | | | | | |
| | Inputs | | | | | |
| | NPK | $ | 156 | 128 | 128 | **411** |
| | Borax | $ | 412 | 272 | 275 | **959** |
| | Glyphosate | $ | 43 | 43 | 43 | **128** |
| | | | | | | |
| | Fungicide - Kocide | $ | 120 | 120 | 120 | **360** |
| | | | | | | |
| | Papaya Seedlings | | | | | |
| | Plants @$1 | $ | 1667 | 0 | 0 | **1667** |
| | **Total Inputs Costs** | | **2398** | **562** | **565** | **3525** |
| | | | | | | |
| | **Machinery Inputs** | | | | | |
| | Ploughing | hour | 300 | 0 | 0 | **300** |
| | Harrowing | hour | 200 | 0 | 0 | **200** |
| | Ridging | hour | 80 | 0 | 0 | **80** |
| | **Sub Total** | | **580** | 0 | 0 | **580** |
| | | | | | | |
| 4 | **Labour Inputs (person day)** | | | | | |
| | Sowing of Seedlings in Polythene bags | personday | 2 | 0 | 0 | **2** |
| | Planting | personday | 15 | 0 | 0 | **15** |
| | Fertiliser Application | personday | 35 | 24 | 24 | **83** |
| | Spraying | personday | 15 | 10 | 10 | **35** |
| | Weeding | personday | 10 | 10 | 10 | **30** |
| | Harvesting | personday | 15 | 20 | 20 | **55** |
| | Sorting/Grading | personday | 10 | 20 | 10 | **40** |
| | Total Labour Days | | 102 | 84 | 74 | **260** |
| | **Total Labour Costs @$20/day** | $ | **2040** | **1680** | **1480** | **5,200** |
| | | | | | | |
| **5** | Transport | $ | 2700 | 5000 | 3750 | **11,450** |
| | | | | | | |
| **6** | **Total Variable Costs** | $ | **7,718** | **7,242** | **5,795** | **$20,755** |
| **7** | **Gross Margin/ha including Labour** | $ | **46,282** | **64,758** | **48,205** | **$159,245** |
| **8** | **Return/Labour Inputs** | $ | | | | **$612.48** |
| **9** | **Breakeven Price/kg** | $ | 0.26 | 0.18 | 0.19 | |
| **10** | **Breakeven Yield** | kg | **3858.8** | **3621.2** | **2897.6** | |
| | | | | | | |
| **11** | ***Establishment Cost*** | | | | | |
| | **Seedlings** | | | | | **$1,667** |
| | **Labour** | | | | | **$5,200** |
| | **TOTAL** | | | | | **$6,867** |

| | **Papaya - Yield (kg/ha)** | **Marketable Yield 90%** | Price($/kg) | | |
|---|---|---|---|---|---|
| | | | 2 | 3 | 4 |
| 1 | 15000 | 13500 | 21,205 | 34,705 | 48,205 |
| 2 | 20000 | 18000 | 30,205 | 48,205 | 66,205 |
| 3 | 25000 | 22500 | 39,205 | 61,705 | 84,205 |
| 4 | 30000 | 27000 | 48,205 | 75,205 | 102,205 |

## 9.42 Gross Margin for Cardamom

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Organic Non Mechanised System* | | | | | |
| 1 | Spacing - 1.8m x 1.8m | | | | Planting Density | 3086 plants |
| | | | | | | |
| 2 | Production & Income Schedule | | Year 1 | Year 2 | Year 3 | Total |
| | | | | | | |
| | Area | ha | 1 | | | |
| | Yield/ha (Dry) | kg | 0 | 0 | 500 | |
| | Production (Dry) | kg | 0 | 0 | 500 | |
| | Marketable Production (90%) | kg | 0 | 0 | 450 | |
| | Price/kg | $ | 0 | 0 | 40 | |
| | **Gross Value of Output** | **$** | **0** | **0** | **18000** | **18,000** |
| | | | | | | |
| | **Direct Costs** | | | | | |
| | Seeds - 60kg | $ | 66 | | | **66** |
| | **Total Inputs Costs** | | **66** | **0** | **0** | **66** |
| | | | | | | |
| | | | | | | |
| 4 | **Labour Inputs (person day)** | | | | | |
| | Land Clearing | personday | 15 | 0 | 0 | **15** |
| | Digging & Planting | personday | 15 | 0 | 0 | **15** |
| | Weeding | personday | 10 | 10 | 10 | **30** |
| | Mulching of Plants | personday | 10 | 10 | 10 | **30** |
| | Harvesting | personday | 0 | 0 | 20 | **20** |
| | Drying | personday | 0 | 0 | 15 | **10** |
| | Sorting/Grading | personday | 0 | 0 | 10 | **10** |
| | Total Labour Days | | **50** | **20** | **65** | **130** |
| | **Total Labour Costs @$20/day** | $ | **1000** | **400** | **1300** | **2600** |
| | | | | | | |
| 5 | Transport | $ | 200 | 0 | 62.5 | **263** |
| | | | | | | |
| 6 | **Total Variable Costs** | $ | **1,266** | **400** | **1,363** | **$3,029** |
| 7 | **Gross Margin/ha including Labour** | $ | **0** | **0** | **16,638** | **14,972** |
| 8 | **Return/Labour Inputs** | $ | | | | **$115.17** |
| 9 | **Breakeven Price/kg** | $ | | | 2.73 | |
| 10 | **Breakeven Yield** | kg | | | 34.1 | |
| | | | | | | |
| 11 | ***Establishment Cost*** | | | | | |
| | **Planting Material** | | | | | **$66** |
| | **Labour** | | | | | **$2,600** |
| | **TOTAL** | | | | | **$2,666** |

# 9.43 Gross Margin for Cinnamon

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Organic Non Mechanised System* | | | | | | | |
| 1 | Spacing - 3m x 3m | | | | Planting Density | | | 1,111 plants |
| | | | | | | | | |
| 2 | Production & Income Schedule | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | **Total** |
| | | | | | | | | |
| | Area | ha | 1 | | | | | |
| | Yield/ha (Dry) | kg | 0 | 0 | 2,500 | 2,500 | 2,500 | |
| | Production (Dry) | kg | 0 | 0 | 0 | 0 | 2,500 | |
| | Marketable Production (90%) | kg | 0 | 0 | 0 | 0 | 2,250 | |
| | Price/kg | $ | 0 | 0 | 0 | 0 | 15 | |
| | **Gross Value of Output** | **$** | **0** | **0** | **0** | **0** | **33750** | **33,750** |
| | | | | | | | | |
| | **Direct Costs** | | | | | | | |
| | Seedlings - | $ | 1111 | 0 | 0 | 0 | 0 | **1111** |
| | **Total Inputs Costs** | | **1111** | **0** | **0** | **0** | **0** | **1111** |
| | | | | | | | | |
| | | | | | | | | |
| 3 | **Labour Inputs (person day)** | | | | | | | |
| | Land Clearing | personday | 15 | 0 | 0 | 0 | 0 | **15** |
| | Digging & Planting | personday | 15 | 0 | 0 | 0 | 0 | **15** |
| | Weeding | personday | 10 | 10 | 10 | 10 | 10 | **30** |
| | Mulching of Plants | personday | 10 | 10 | 0 | 0 | 0 | **20** |
| | Prunning | personday | 0 | 0 | 5 | 5 | 5 | **15** |
| | Stripping of bark | personday | 0 | 0 | 0 | 0 | 10 | **0** |
| | Drying | personday | 0 | 0 | 15 | 0 | 0 | **10** |
| | Grading and Packing | personday | 0 | 0 | 10 | 0 | 0 | **10** |
| | Total Labour Days | | **50** | **20** | **40** | **15** | **25** | **150** |
| | **Total Labour Costs @$20/day** | $ | **1000** | **400** | **800** | **300** | **500** | **3000** |
| | | | | | | | | |
| 4 | Transport | $ | 200 | 0 | 0 | 0 | 500 | **700** |
| | | | | | | | | |
| 5 | **Total Variable Costs** | $ | **2,311** | **400** | **800** | **300** | **1,000** | **$4,811** |
| 6 | **Gross Margin/ha including Labour** | $ | **0** | **0** | **0** | **0** | **32,750** | **32,750** |
| 7 | **Return/Labour Inputs** | $ | | | | | | **$32.07** |
| 8 | **Breakeven Price/kg** | $ | | | | | 1.92 | |
| 9 | **Breakeven Yield** | kg | | | | | 320.7 | |
| | | | | | | | | |
| 10 | ***Establishment Cost*** | | | | | | | |
| | **Seedlings** | | | | | | | **$1,111** |
| | **Labour** | | | | | | | **$3,000** |
| | **TOTAL** | | | | | | | **$4,111** |

# 9.44 Gross Margin for Nutmeg

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Gross Margin for Nutmeg (*Myristica fragrans*)** | | | | | | | | | |
| | *Farming System - Cultivated under Organic - Non Mechanised System* | | | | | | | | | |
| 1 | Spacing - 8m x 8m | | | | Planting Density | | | | | 156 plants |
| | | | | | | | | | | |
| 2 | Production & Income Schedule | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | **Total** |
| | | | | | | | | | | |
| | Area | ha | 1 | | | | | | | |
| | Yield/ha (Dry) | kg | 0 | 0 | 0 | 0 | 0 | 0 | 1,092 | |
| | Production (Dry) | kg | 0 | 0 | 0 | 0 | 0 | | 1,092 | |
| | Marketable Production (90%) | kg | 0 | 0 | 0 | 0 | 0 | 0 | 983 | |
| | Price/kg | $ | 0 | 0 | 0 | 0 | 0 | 0 | 25 | |
| | **Gross Value of Output** | **$** | **0** | **0** | **0** | **0** | **0** | **0** | **24,570** | **0** |
| | | | | | | | | | | |
| | **Direct Costs** | | | | | | | | | |
| | Seedlings - 156 | $ | 156 | 0 | 0 | 0 | 0 | 0 | 0 | **156** |
| | **Total Inputs Costs** | | **156** | **0** | **0** | **0** | **0** | **0** | **0** | **156** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **3** | **Labour Inputs (person day)** | | | | | | | | | |
| | Land Clearing | personday | 15 | 0 | 0 | 0 | 0 | 0 | 0 | **15** |
| | Digging & Planting | personday | 15 | 0 | 0 | 0 | 0 | 0 | 0 | **15** |
| | Weeding | personday | 10 | 10 | 10 | 10 | 10 | 10 | 10 | **70** |
| | Mulching of Plants | personday | 5 | 5 | 5 | 5 | 5 | 5 | 5 | **35** |
| | Prunning | personday | 0 | 0 | 5 | 5 | 5 | 5 | 5 | **25** |
| | Harvesting of nuts | personday | 0 | 0 | 0 | 0 | 0 | 0 | 10 | **10** |
| | Drying | personday | 0 | 0 | 0 | 0 | 0 | 0 | 20 | **20** |
| | Grading and Packing | personday | 0 | 0 | 10 | 0 | 0 | 0 | 10 | **20** |
| | Total Labour Days | | **45** | **15** | **30** | **20** | **20** | **20** | **60** | **210** |
| | **Total Labour Costs @$20/day** | $ | **900** | **300** | **600** | **400** | **400** | **400** | **1200** | **4200** |
| | | | | | | | | | | |
| 4 | Transport | $ | 200 | 0 | 0 | 0 | 0 | 0 | 200 | **400** |
| | | | | | | | | | | |
| **5** | **Total Variable Costs** | $ | **1,256** | **300** | **600** | **400** | **400** | **400** | **1,400** | **4,756** |
| **6** | **Gross Margin/ha including Labour** | $ | **0** | **0** | **0** | **0** | **0** | **0** | **23,170** | |
| **7** | **Return/Labour Inputs** | $ | | | | | | | | **$110.33** |
| **8** | **Breakeven Price/kg** | $ | | | | | | | 1.28 | |
| **9** | **Breakeven Yield** | kg | | | | | | | 56.0 | |
| | | | | | | | | | | |
| **10** | ***Establishment Cost*** | | | | | | | | | |
| | **Seedlings** | | | | | | | | | **$156** |
| | **Labour** | | | | | | | | | **$4,200** |
| | **TOTAL** | | | | | | | | | **$4,356** |
| | | | | | | | | | | |

# 9.45 Gross Margin for Vanilla

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Gross Margin for Vanilla** *(Vanilla fragrans)* | | | | | |
| | *Farming System - Cultivated under Organic Non Mechanised System* | | | | | |
| 1 | Spacing - 3m x 3m | | | | Planting Density | 1111 plants |
| | | | | | | |
| 2 | Production & Income Schedule | | Year 1 | Year 2 | Year 3 | Total |
| | | | | | | |
| | Area | ha | 1 | | | |
| | Yield/ha | kg | 0 | 0 | 600 | |
| | Production (Cured Beans) | kg | 0 | 0 | 600 | |
| | Marketable Production (90%) | kg | 0 | 0 | 540 | |
| | Price/kg | $ | 0 | 0 | 60 | |
| | **Gross Value of Output** | **$** | **0** | **0** | **32400** | **32,400** |
| | | | | | | |
| | **Direct Costs** | | | | | |
| | ***Inputs*** | | | | | |
| | Vanilla Cuttings | $ | 1111 | 0 | 0 | **1111** |
| | | | | | | |
| | **Total Inputs Costs** | | **1111** | **0** | **0** | **1111** |
| | | | | | | |
| 4 | **Labour Inputs (person day)** | | | | | |
| | Land Clearing | personday | 15 | 0 | 0 | **15** |
| | Planting of Support Trees | personday | 15 | 0 | 0 | **15** |
| | Mulching | personday | 8 | 8 | 8 | **24** |
| | Weeding | personday | 10 | 10 | 10 | **30** |
| | Looping | personday | 8 | 8 | 8 | **24** |
| | Pollination | personday | 0 | 0 | 10 | **10** |
| | Harvesting | personday | 0 | 0 | 20 | **20** |
| | Curing of Beans | personday | 0 | 0 | 20 | **20** |
| | Sun Drying | personday | 0 | 0 | 8 | **8** |
| | Sorting/Grading | personday | 0 | 0 | 5 | **5** |
| | Total Labour Days | | 56 | 26 | 89 | **171** |
| | **Total Labour Costs @$20/day** | $ | **1120** | **520** | **1780** | **3,420** |
| | | | | | | |
| **5** | Transport | $ | 200 | 0 | 200 | **400** |
| | | | | | | |
| **6** | **Total Variable Costs** | $ | **2,431** | **520** | **1,980** | **$4,931** |
| **7** | **Gross Margin/ha including Labour** | $ | **-2,431** | **-520** | **30,420** | **$27,469** |
| **8** | **Return/Labour Inputs** | $ | | | | **$160.64** |
| **9** | **Breakeven Price/kg** | $ | | | 3.30 | |
| **10** | **Breakeven Yield** | kg | | | **33.0** | |
| | | | | | | |
| **11** | ***Establishment Cost*** | | | | | |
| | **Planting Material** | | | | | **$1,111** |
| | **Labour** | | | | | **$3,420** |
| | **TOTAL** | | | | | **$4,531** |

# 9.46 Gross Margin for Sugarcane

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Mechanised System* | | | | | | |
| 1 | Spacing - 1.3m (The bottom of the drill to be 15-20cm below ground level) | | | | | | |
| | | | | | | | |
| 2 | Production & Income Schedule | | Year 1 | Year 2 | Year 3 | Year 4 | Total |
| | | | | | | | |
| | Area | ha | 1 | | | | |
| | Yield/ha | ton | 75 | 80 | 80 | 75 | |
| | Production | ton | 75 | 80 | 80 | 75 | |
| | Marketable Production (90%) | ton | 68 | 72 | 72 | 68 | |
| | Price/ton | $ | 80 | 80 | 80 | 80 | |
| | **Gross Value of Output** | **$** | **5400** | **5760** | **5760** | **5400** | **16,920** |
| | | | | | | | |
| 3 | **Direct Costs** | | | | | | |
| | **Inputs** | | | | | | |
| | Blend A | $ | 240 | 0 | 0 | 0 | **240** |
| | Blend B | $ | 840 | 0 | 0 | 0 | **840** |
| | Blend C | $ | 0 | 960 | 960 | 960 | **2880** |
| | Velpar K4 | $ | 141.48 | 0 | 0 | 0 | **141.48** |
| | 2,4-D Amine | $ | 175.6 | 175.6 | 175.6 | 175.6 | **526.8** |
| | | | | | | | |
| | Planting Materials | $ | 2500 | 0 | 0 | 0 | **2500** |
| | **Total Inputs Costs** | | **3897** | **1136** | **1136** | **1136** | **7304** |
| | | | | | | | |
| 4 | **Machinery Inputs** | | | | | | |
| | Ploughing | $ | 300 | 0 | 0 | 0 | **300** |
| | Harrowing | $ | 200 | 0 | 0 | 0 | **200** |
| | Ridging | $ | 80 | 0 | 0 | 0 | **80** |
| | **Total** | | **580** | 0 | 0 | 0 | **580** |
| | | | | | | | |
| | | | | | | | |
| **5** | **Labour Inputs (person day)** | | | | | | |
| | Planting | personday | 15 | 0 | 0 | 0 | **15** |
| | Weed Control | personday | 10 | 10 | 10 | 10 | **40** |
| | Fertilizer Application | personday | 8 | 8 | 8 | 8 | **32** |
| | Harvesting | personday | 20 | 20 | 20 | 20 | **80** |
| | Sorting & Loading | personday | 10 | 10 | 10 | 10 | **40** |
| | Total Labour Days | personday | 63 | 48 | 48 | 48 | **207** |
| | **Total Labour Costs @$20/day** | $ | **1260** | **960** | **960** | **960** | **4140** |
| | | | | | | | |
| **6** | Transport | $ | 1000 | 1000 | 1000 | 1000 | **4,000** |
| | | | | | | | |
| **7** | **Total Variable Costs** | $ | **6,737** | **3,096** | **3,096** | **3,096** | **16,024** |
| **8** | **Gross Margin/ha including Labour** | $ | **-1,337** | **2,664** | **2,664** | **2,304** | **$6,296** |
| **9** | **Return/Labour Inputs** | $ | | | | | **$30.42** |
| **10** | **Breakeven Price/ton** | $ | **89.83** | **38.70** | **38.70** | **41.27** | |
| **11** | **Breakeven Yield** | ton | **84.2** | **38.7** | **38.7** | **38.7** | |
| | | | | | | | |
| **12** | ***Establishment Cost*** | | | | | | |
| | **Planting Material** | | | | | | **$2,500** |
| | **Land Preparation** | | | | | | **$580** |
| | **Labour** | | | | | | **$1,260** |
| | **TOTAL** | | | | | | **$4,340** |

# 9.47 Gross Margin for Yasi (Sandalwood)

| | Gross Margin for Yasi (*Santalum Yasi*) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Farming System - Cultivated under Traditional System* | | | | | | | | | | | | | | | | |
| 1 | **Spacing - 5m x 5m** | | | | | | | | | | | **Plant Density - 400 plants** | | | | | |
| | | | | | | | | | | | | | | | | | |
| 2 | ***Production & Income Schedule*** | | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Year 6** | **Year 7** | **Year 8** | **Year 9** | **Year 10** | **Year 11** | **Year 12** | **Year 13** | **Year 14** | **Year 15** |
| | | | | | | | | | | | | | | | | | |
| | Area | ha | 1 | | | | | | | | | | | | | | |
| | Yield/ha | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25,000 |
| | Production | kg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25,000 |
| | Price/kg | $ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| | **Gross Value of Output** | **$** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **2,500,000** |
| | | | | | | | | | | | | | | | | | |
| 3 | **Direct Costs** | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | Yasi Seedlings | $ | 400 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 400 |
| | **Total Inputs Costs** | **$** | **400** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **400** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 4 | **Labour Inputs (person day)** | | | | | | | | | | | | | | | | |
| | Land Clearing | personday | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| | Planting | personday | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| | Weed Control | personday | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 112 |
| | Mulching | personday | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 112 |
| | Harvesting | personday | 0 | 0 | 0 | 0 | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sorting & Loading | personday | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total Labour Days | personday | **41** | **16** | **16** | **16** | **16** | **16** | **16** | **16** | **16** | **16** | **16** | **16** | **16** | **16** | **249** |
| | **Total Labour Costs @$20/day** | $ | **820** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **4980** |
| | | | | | | | | | | | | | | | | | |
| 5 | Transport | $ | 0 | 0 | 0 | 0 | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1250 |
| | | | | | | | | | | | | | | | | | |
| 6 | **Total Variable Costs** | $ | **1,220** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **320** | **6,630** |
| 7 | **Gross Margin/ha including Labour** | $ | **-1,220** | **-320** | **-320** | **-320** | **-320** | **-320** | **-320** | **-320** | **-320** | **-320** | **-320** | **-320** | **-320** | **-320** | **$2,493,370** |
| 8 | **Return/Labour Inputs** | $ | | | | | | | | | | | | | | | **501** |
| 9 | **Breakeven Price/kg** | $ | | | | | | | | | | | | | | | **0.2652** |
| 10 | **Breakeven Yield** | kg | | | | | | | | | | | | | | | **66.3** |
| | | | | | | | | | | | | | | | | | |
| 11 | ***Establishment Cost*** | | | | | | | | | | | | | | | | |
| | **Seedlings** | | | | | | | | | | | | | | | | **$400.00** |
| | **Labour** | | | | | | | | | | | | | | | | **$4,980.00** |
| | **TOTAL** | | | | | | | | | | | | | | | | **$5,380.00** |
| | | | | | | | | | | | | | | | | | |

# Chapter 10 | Gross Margin for Livestock

# 10.1 Gross Margin for Tilapia

| *Assumptions* | | | | |
|---|---|---|---|---|
| ***Production Income & Schedule*** | Unit | | | |
| Area of Pond | square meter | 1000 | | |
| Stocking rate of fish per square meter | number | 5 | | |
| Number of Turnover/Year | number | 2 | | |
| Total Number of Fish | number | 5000 | | |
| Average Weight/Fish | kg | 0.2 | | |
| Total Weight | kg | 2000 | | |
| Marketable 95% | kg | 1600 | | |
| Price per kg | $ | 5 | | |
| ***Income*** | ***$*** | ***$16,000*** | | **$16,000** |
| | | | | |
| ***Variable Costs*** | **Unit** | **Unit Cost** | **Quantity** | **Total Cost** |
| Feed - Tilapia Mesh | 25kg bag | 35.64 | 17 | 605.88 |
| Tilapia Pellet | 25kg bag | 31.57 | 144 | 4546.08 |
| ***Labour*** | | | | |
| Feeding | personday | 20 | 8 | 160 |
| Harvesting | personday | 20 | 4 | 80 |
| Cleaning of Pond | personday | 20 | 2 | 40 |
| **Total** | | | | **280** |
| | | | | |
| Tranport | trip | 2 | 200 | 400 |
| | | | | |
| ***Total Variable Costs*** | | | | ***5831.96*** |
| ***Gross Margin*** | | | | ***$10,168*** |
| ***Breakeven Price/kg*** | ***$*** | | | ***3*** |
| ***Breakeven Yield*** | ***kg*** | | | ***1166*** |
| | | | | |
| ***Establishment Costs*** | | | | |
| Excavation of Fish Pond - $4,500 | | | | |
| Installation of Pipe - $2500 | | | | |
| Total - $8,000 | | | | |
| Return on Investment - 73.51% (With a Capital Investment of $13,831 the above figure of $10,168 represents a return to capital of 73.51%) | | | | |



## 10.2 Gross Margin for Freshwater Prawns

| *Assumptions* | | | | |
|---|---|---|---|---|
| ***Production Income & Schedule*** | **Unit** | | | |
| Area of Pond | square meter | 1000 | | |
| Stocking Rate of prawn per square meter | number | 5 | | |
| Number of Turnover/Year | number | 2 | | |
| Total Number of Prawn | number | 5000 | | |
| Average Market Weight/Prawn | kg | 0.035 | | |
| Total Weight | kg | 350 | | |
| Marketable 95% | kg | 332.5 | | |
| Price per kg | $ | 27 | | |
| ***Income*** | ***$*** | ***$17,955*** | | **$17,955** |
| | | | | |
| ***Variable Costs*** | **Unit** | **Unit Cost** | **Quantity** | **Total Cost** |
| Feed - Tilapia Mesh | 25 kg bags | 35.64 | 15 | 534.6 |
| Tilapia Pellet | 25kg bag | 31.57 | 110 | 3472.7 |
| ***Labour*** | | | | |
| Feeding | personday | 20 | 8 | 160 |
| Harvesting | personday | 15 | 4 | 60 |
| Cleaning of Pond | personday | 20 | 2 | 40 |
| **Total** | | | | **260** |
| | | | | |
| Tranport | trip | 2 | 200 | 400 |
| | | | | |
| ***Total Variable Costs*** | | | | ***4,667.30*** |
| ***Gross Margin*** | | | | ***13,287.70*** |
| ***Breakeven Price/kg*** | ***$*** | | | ***$13.34*** |
| ***Breakeven Yield*** | ***kg*** | | | ***173*** |
| | | | | |
| ***Capital Costs*** | | | | |
| Excavation of Fish Pond - $4,500 | | | | |
| Installation of Pipe - $2500 | | | | |
| Total - $8,000 | | | | |
| Return on Investment - 104% (With a Capital Investment of $12,667 the above figure of $13,287 represents a return to capital of 104%) | | | | |

# 10.3 Gross Margin for Broiler Birds

| GROSS MARGIN FOR 3000 BROILER BIRDS | | | | | | | | Birds Housed | 3000 |
|---|---|---|---|---|---|---|---|---|---|
| BROILER PERFORMANCE DATA | | | | | | | | 2% Mortality | 2940 |
| Age | Weight for Age | Daily Weight Gain | Daily Feed Consumption | Cumulative Feed Consumption (g) | Cumulative Feed bags | Feed Cost/Bird | Approximate Feed Costs | 6% Mortality | 2820 |
| 0 | 42 | | | | | | | | |
| 1 | 52 | 10 | | | | | | | |
| 2 | 66 | 14 | | | | | | | |
| 3 | 81 | 15 | | | | | | | |
| 4 | 100 | 19 | | | | | | | |
| 5 | 122 | 22 | | | | | | | |
| 6 | 148 | 26 | | | | | | | |
| 7 | 177 | 29 | | 190 | 23 | $0.33 | $980.40 | | |
| 8 | 208 | 31 | 35 | 225 | 27 | $0.99 | $1,161.00 | | |
| 9 | 242 | 34 | 37 | 262 | 31 | $0.45 | $1,351.92 | | |
| 10 | 279 | 37 | 40 | 302 | 36 | $0.52 | $1,558.32 | | |
| 11 | 320 | 41 | 45 | 347 | 42 | $0.60 | $1,790.52 | | |
| 12 | 364 | 44 | 50 | 397 | 48 | $0.68 | $2,048.52 | | |
| 13 | 410 | 46 | 55 | 452 | 54 | $0.78 | $2,332.32 | | |
| 14 | 459 | 49 | 60 | 512 | 61 | $0.88 | $2,641.92 | | |
| 15 | 511 | 52 | 66 | 578 | 69 | $0.99 | $2,982.48 | | |
| 16 | 567 | 56 | 72 | 650 | 78 | $1.12 | $3,354.00 | | |
| 17 | 626 | 59 | 78 | 728 | 87 | $1.25 | $3,681.35 | | |
| 18 | 688 | 62 | 84 | 812 | 97 | $1.36 | $4,010.63 | | |
| 19 | 753 | 65 | 90 | 902 | 108 | $1.52 | $4,455.16 | | |
| 20 | 821 | 68 | 96 | 998 | 120 | $1.64 | $4,811.96 | | |
| 21 | 891 | 70 | 102 | 1100 | 129 | $1.85 | $5,433.12 | | |
| 22 | 963 | 72 | 109 | 1209 | 142 | $2.03 | $5,971.49 | | |
| 23 | 1036 | 73 | 116 | 1325 | 156 | $2.23 | $6,544.44 | | |
| 24 | 1110 | 74 | 123 | 1448 | 170 | $2.43 | $7,151.96 | | |
| 25 | 1185 | 75 | 130 | 1578 | 186 | $2.65 | $7,794.06 | | |
| 26 | 1261 | 76 | 145 | 1723 | 203 | $2.89 | $8,510.24 | | |
| 27 | 1338 | 77 | 155 | 1878 | 221 | $3.16 | $9,275.84 | | |
| 28 | 1416 | 78 | 165 | 2043 | 240 | $3.43 | $10,090.79 | | |
| 29 | 1495 | 79 | 170 | 2213 | 260 | $3.63 | $10,670.20 | | |
| 30 | 1576 | 81 | 179 | 2392 | 281 | $3.92 | $11,533.27 | | |
| 31 | 1658 | 82 | 178 | 2570 | 302 | $4.21 | $12,391.51 | | |
| 32 | 1740 | 82 | 185 | 2755 | 324 | $4.52 | $13,283.51 | | |
| 33 | 1822 | 82 | 190 | 2945 | 346 | $4.83 | $14,199.61 | | |
| 34 | 1905 | 83 | 197 | 3142 | 369 | $5.15 | $14,531.12 | | |
| 35 | 1988 | 83 | 205 | 3347 | 394 | $5.49 | $15,479.21 | | |
| 36 | 2072 | 84 | 206 | 3553 | 401 | $5.83 | $16,431.91 | | |
| 37 | 2158 | 86 | 210 | 3763 | 424 | $6.17 | $17,403.12 | | |
| 38 | 2246 | 88 | 212 | 3975 | 448 | $6.52 | $18,383.58 | | |
| 39 | 2335 | 89 | 214 | 4189 | 473 | $6.87 | $19,373.29 | | |
| 40 | 2425 | 90 | 215 | 4404 | 497 | $7.22 | $20,367.62 | | |
| 41 | 2517 | 92 | 216 | 4620 | 521 | $7.58 | $21,366.58 | | |
| 42 | 2609 | 92 | 217 | 4837 | 546 | $7.93 | $22,370.16 | | |
| 43 | 2700 | 91 | 218 | 5055 | 570 | $8.29 | $23,378.36 | | |
| 44 | 2790 | 90 | 219 | 5274 | 595 | $8.65 | $24,391.20 | | |
| 45 | 2879 | 89 | 220 | 5494 | 620 | $9.01 | $25,408.65 | | |
| 46 | 2967 | 88 | 221 | 5715 | 645 | $9.37 | $26,430.73 | | |
| 47 | 3054 | 87 | 222 | 5937 | 670 | $9.74 | $27,457.44 | | |
| 48 | 3140 | 86 | 223 | 6160 | 695 | $10.10 | $28,488.77 | | |
| 49 | 3225 | 85 | 224 | 6384 | 720 | $10.47 | $29,524.72 | | |
| 50 | 3309 | 84 | 225 | 6609 | 745 | $10.84 | $30,565.30 | | |
| 51 | 3392 | 83 | 226 | 6835 | 771 | $11.21 | $31,610.51 | | |
| 52 | 3474 | 82 | 226 | 7061 | 796 | $11.58 | $32,655.51 | | |
| 53 | 3555 | 81 | 227 | 7288 | 822 | $11.95 | $33,705.54 | | |
| 54 | 3635 | 80 | 227 | 7515 | 848 | $12.32 | $34,755.37 | | |
| 55 | 3714 | 79 | 228 | 7743 | 873 | $12.70 | $35,809.83 | | |
| 56 | 3792 | 78 | 228 | 7971 | 899 | $13.07 | $36,864.28 | | |
| | | (Cells highlight in Yellow are variables and can be changed based on farmer capability) | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| . | Date of Placement | 07/02/2013 | | Feed Cost/Bird | | |
| | Number Placed: | 3000 | | | Total Broiler Feed Used | 497.00 |
| | Day old Price | $1.10 | | | Average Feed Price | 42.00 |
| | | | | | | |
| | Birds Available for Sale | 2820 | | | Total Feed Cost | 20,874.00 |
| | Market Age (days) | 40 | | | Cost Summary | |
| | Average Liveweight Bird (kg) | 2425 | | | Day old Cost | $3,300.00 |
| | Kilogram available for Sale | 6838.5 | | | Feed | $20,874.00 |
| | | | | | Transport | $240.00 |
| | Sale Price | $2.80/kg | | | Medication | $547.08 |
| | Expected Sales Value | $19,147.80 | | | Total Cost | $24,961.08 |
| | | | | | | |
| | **FCR** | **1.8169** | | | | |
| | **Net Profit** | **($5,813.28)** | | | | |

## 10.4 Gross Margin for Layer Birds

| Production Schedule and Income | | | | Weekly | Annual |
|---|---|---|---|---|---|
| No. of Birds | | | | 10,000 | 10,000 |
| No. of trays per week (30 eggs per tray = 60,000 eggs per week = 6 eggs/layer/week = 1 egg/layer/day | | | | 1,633 | 84,916 |
| Price per Tray | | | | $8 | $8 |
| **Income from Eggs** | | | | **$13,064** | **$679,328** |
| **Income from Culled Layers** | **9000** | **$8/bird** | | | **$72,000** |
| *TOTAL INCOME* | | | | | *$751,328* |
| **VARIABLE COSTS** | **Unit** | **Quantity** | **Unit Cost** | **Costings** | |
| | | | | **Weekly** | **Annual** |
| Feeds | | | | | |
| Grower Crumble | number of 25kg bags | 24 | 31 | 744 | 38,688 |
| Layer Mesh | number of 25kg bags | 330 | 33.5 | 11,055 | 574,860 |
| Grower Starter 9 bags per week @$29 | number of 25kg bags | 9 | 29 | 261 | 13,572 |
| TOTAL VARIABLE COSTS | | | | | $627,120 |
| **GROSS MARGIN** | | | | | **$124,208** |
| | | | | | |
| **ESTABLISHMENT COSTS** | | | | | |
| Infrastrusture = 5 Sheds | | | | | **$200,000** |
| Vehicles - 2 | | | | | **$60,000** |
| Total Establishment Cost | | | | | **$260,000** |
| | | | | | |



## 10.5 Gross Margin for Beef Cattle

| | | | | |
|---|---|---|---|---|
| Enterprise : Fattening Steers for 3 years with some supplementary feeding | | | | |
| Enterprise Unit : 100 Steers | | | | |
| Pasture : Improved Pasture | | | | |
| | | | | |
| ***Production Schedule and Income*** | | | | |
| Steer Sale after 3 years | | | | 88 |
| Price per Steer | | | | 1000 |
| **A. TOTAL INCOME** | | | | **$88,000** |
| | | | | |
| ***Variable Costs*** | **Unit** | **Quantity** | **Unit Cost** | **Total Cost** |
| Steer Purchase 100 Steers @ $350 | number | 100 | 350 | 35000 |
| Cartage to Property 100 steers | number | 100 | 10 | 1000 |
| Livestock and Vet Costs | number | 100 | 10 | 1000 |
| Other Cost | | | | |
| Fodder Crops - 12ha per 100 Steers $1,800 | ha | 12 | 1800 | 21600 |
| Hay and Coconut Meal ( Droughts can increase feed costs) | tons | 12 | 400 | 4800 |
| Pasture Maintenance 97 ha- improved pasture) | ha | 97 | 120 | 11640 |
| Livestock Selling Cost | number | 88 | 10 | 880 |
| | | | | |
| **B. TOTAL VARIABLE COSTS** | | | | **$75,920** |
| | | | | |
| **C. GROSS MARGIN** | | | | **$12,080** |
| **GROSS MARGIN/STEER** | | | | **$137.27** |
| SIMPLE RATE OF RETURN | | | | 15.91% |
| | | | | |
| **ESTABLISHMENT COSTS** | **Unit** | **Quantity** | **Unit Cost** | **Total Costs** |
| Fencing | km | 10 | 1500 | 15000 |
| Cattle Stock | number | 100 | 350 | 35000 |
| Stockyard | number | 1 | 3000 | 3000 |
| | | | | $53,000 |
| | | | | |

# 10.6 Gross Margin for a 20 Cow Dairy Unit

| | Production & Income Schedule | Unit | Total | | |
|---|---|---|---|---|---|
| | ***Fresh Milk*** | | | | |
| | Number of Cows | number | 20 | | |
| | Average Milk per Cow | litres | 8 | | |
| | Daily Production | litres | 120 | | |
| | Price/litre | $ | 0.7 | | |
| | Daily Income | $ | 84 | | |
| | Annual Milk Production | litres | 32400 | | |
| | **Annual Milk Sales** | **$** | **$22,680** | | |
| | Culled Stock | number | 2 | | |
| | Price per herd | $ | 600 | | |
| | **Sales of Culled Stock** | **$** | **1200** | | |
| | Sales of Steers | number | 10 | | |
| | Price per steer | $ | 400 | | |
| | **Sales of Steers** | **$** | **4000** | | |
| *A* | **TOTAL INCOME DERIVED** | **$** | **$27,880** | | |
| | | | | | |
| *B* | ***Variable Costs*** | | | | |
| | Cocentrates | | 10074 | | |
| | Vet Drugs | | 100 | | |
| | Labour - Milking, Management and Seasonal Casuals | | 4050 | | |
| | Fencing Repairs | | 434.16 | | |
| | Transport Costs | | 250 | | |
| | Miscellanous | | 200 | | |
| *C* | ***Total Variable Costs*** | | ***15108.16*** | | |
| | | | | | |
| *D* | ***Establishment Cost*** | ***Unit*** | ***Quantity*** | ***Unit Cost*** | ***Total*** |
| | Fencing | km | 5 | 1500 | **7500** |
| | Milking Cows | no. | 20 | 1000 | **20000** |
| | Breeding Bulls | no. | 1 | 1000 | **1000** |
| | **TOTAL** | | | | **$28,500** |
| | | | | | |
| | ***Gross Margin*** | | | | |
| | Breakeven (Milk Production) | litres | | | **17,331** |
| | Breakeven (Price) | $ | | | **0.46** |
| | Breakeven (Cows) | | | | **10.81** |
| | | | | | |
| | ***Assumptions*** | | | | |
| | Concentrates (per cow) | Ration (kg) | Price/kg | Total | |
| | (Ration formulation is 40% Coconut Meal/60% Mollases | | | | |
| | Copra | 0 | 0.46 | 0.46 | |
| | Mollases | 0 | 0.23 | 0.23 | |
| | Total per day | 2 | 0.69 | 1.38 | |
| | Total per year | | | **$503.70** | |
| | | | | | |
| | ***Labour*** | ***Number*** | ***Rate($)/day*** | ***Total Cost*** | |
| | | 1 | 15 | 15 | |
| | | | | | |
| | ***Fuel Costs*** | ***km*** | ***Rate*** | ***Total Cost*** | |
| | | 5 | 0.04 | 0.2 | |
| | | | | | |
| | ***Maintenance*** | 0 | 0 | 0 | |
| | **Fuel Consumption - 10km/hour** | | | | |
| | **Maintenance $0.02/km** | | | | |
| | | | | | |
| | ***Veterinary Drugs per Animal*** | $5/head | | | |
| | Fence | 2% of yearly milk production | | | |
| | Miscellaneous | 1% of the milk production | | | |

## 10.7 Gross Margin for a 200 Doe Unit

| 1 | *Production & Income Schedule* | Unit | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|---|---|
| | Number of Does | number | 200 | 200 | 200 | 200 | 200 |
| | Number of Goat Kids born | number | 240 | 240 | 240 | 240 | 240 |
| | Mortality 10% | number | 24 | 24 | 24 | 24 | 24 |
| | Number of Kids Sold | number | 108 | 108 | 108 | 108 | 108 |
| | Price per kid | $ | 60 | 60 | 60 | 60 | 60 |
| | **Value of Goat Kids** | **$** | **6480** | **6480** | **6480** | **6480** | **6480** |
| | Replacement Does | number | 30 | 30 | 30 | 30 | 30 |
| | Number of Breeding Does sold | number | 78 | 78 | 78 | 78 | 78 |
| | Price per doe | $ | 70 | 70 | 70 | 70 | 70 |
| | **Value of Breeding Does** | **$** | **5460** | **5460** | **5460** | **5460** | **5460** |
| | Number of Cull Does Sold | number | 20 | 20 | 20 | 20 | 20 |
| | Price per Cull Doe | $ | 100 | 100 | 100 | 100 | 100 |
| | **Value of Cull Doe** | **$** | **2000** | **2000** | **2000** | **2000** | **2000** |
| **2** | ***GROSS INCOME*** | ***$*** | ***$13,940*** | ***$13,940*** | ***$13,940*** | ***$13,940*** | ***$13,940*** |
| | | | | | | | |
| **3** | ***VARIABLE COST*** | | | | | | |
| | Labour | $ | 2600 | 2600 | 2600 | 2600 | 2600 |
| | Feed | $ | 2170 | 2170 | 2170 | 2170 | 2170 |
| | Health | $ | 600 | 600 | 600 | 600 | 600 |
| | Transport | $ | 200 | 200 | 200 | 200 | 200 |
| | Rent | $ | 350 | 350 | 350 | 350 | 350 |
| | ***Maintenance*** | | | | | | |
| | Fencing (3%) | $ | 180 | 180 | 180 | 180 | 180 |
| | Shed | $ | 120 | 120 | 120 | 120 | 120 |
| | Pastures (15%) | $ | 300 | 300 | 300 | 300 | 300 |
| | **TOTAL** | **$** | **$6,520** | **$6,520** | **$6,520** | **$6,520** | **$6,520** |
| | | | | | | | |
| **4** | ***GROSS MARGIN*** | ***$*** | ***$7,420*** | ***$7,420*** | ***$7,420*** | ***$7,420*** | ***$7,420*** |
| | | | | | | | |
| | ***Establishment Costs*** | | | | | | |
| | Fencing - 40ha @$3761/ha | | 15044 | | | | |
| | Stock 200 @$50/head | | 10000 | | | | |
| | Pasture Establishment 40 @$50/ha | | 2000 | | | | |
| | Equipment | | 1000 | | | | |
| | **TOTAL** | **$** | **$28,044** | | | | |

## 10.8 Gross Margin for a 50 Bee Hive Unit

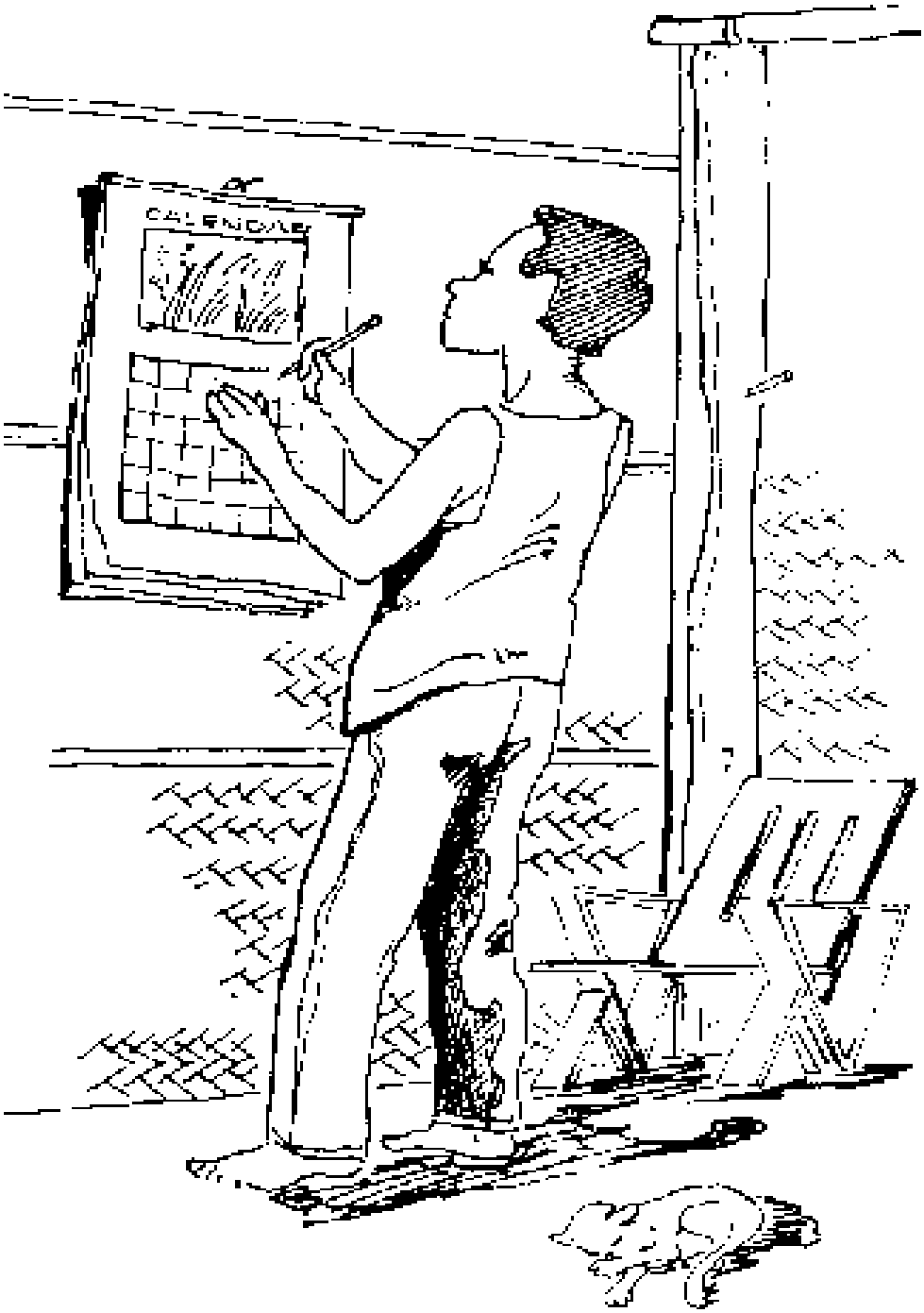
| | *Assumption - Production & Income Schedule* | Unit | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|---|---|
| | Hive No | number | 50 | 60 | 70 | 80 | 90 |
| | Yield per hive | kg | 30 | 30 | 30 | 30 | 30 |
| | Honey Production | kg | 1500 | 1800 | 2100 | 2400 | 2700 |
| | Price per kg | $ | 15 | 15 | 15 | 15 | 15 |
| | Honey Sales | $ | 22500 | 27000 | 31500 | 36000 | 40500 |
| | Bee Wax Production | kg | 40 | 50 | 60 | 70 | 80 |
| | Price per kg | $ | 20 | 20 | 20 | 20 | 20 |
| | Value of Wax | $ | 800 | 1000 | 1200 | 1400 | 1600 |
| **A** | **TOTAL INCOME** | **$** | **23,300** | **28,000** | **32,700** | **37,400** | **42,100** |
| | | | | | | | |
| | ***Variable Costs*** | | | | | | |
| | Harvesting | $ | 100 | 100 | 150 | 240 | 250 |
| | Bottling & Labelling | $ | 1500 | 1800 | 2100 | 2400 | 2700 |
| | Miscellanous, Sugar, Feeding/Transport/Repairs & Maintenance/Expansion | $ | 200 | 1000 | 1500 | 2000 | 2500 |
| **B** | **TOTAL VARIABLE COST** | **$** | **1800** | **2900** | **3750** | **4640** | **5450** |
| **C** | **GROSS MARGIN** | **$** | **$21,500** | **$25,100** | **$28,950** | **$32,760** | **$36,650** |
| | | | | | | | |

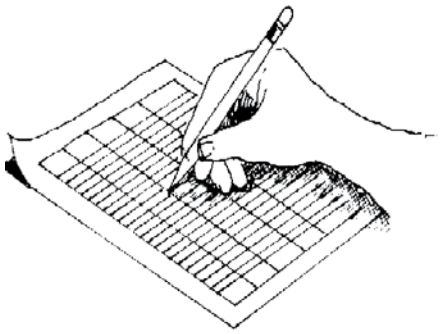
## 10.9 Gross Margin for a 20 Sow Unit

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Total |
|---|---|---|---|---|---|---|
| | | | | | | |
| Sales of stock | | | | | | |
| Sales of stock | $40,404 | $87,808 | $87,808 | $88,808 | $87,808 | |
| Value of stock | $13,444 | $13,600 | $13,600 | $9,600 | $9,600 | |
| ***Gross Pig Sales*** | ***$53,848*** | ***$101,408*** | ***$101,408*** | ***$98,408*** | ***$97,408*** | $452,480 |
| **EXPENDITURE** | | | | | | |
| *Variable Costs* | | | | | | |
| - Feed Costs | $28,922 | $81,331 | $81,331 | $81,331 | $81,331 | |
| - Drug Costs | $169 | $338 | $338 | $338 | $338 | |
| - Labour Costs | $1,800 | $1,800 | $1,800 | $1,800 | $1,800 | |
| - Marketing Costs | | $500 | $500 | $500 | $500 | |
| - Vet Fees | $100 | $200 | $200 | $200 | $200 | |
| ***Total Variable Cost*** | ***$30,990*** | ***$84,168*** | ***$84,168*** | ***$84,168*** | ***$84,168*** | $367,664 |
| *Fixed Costs* | | | | | | |
| - Repair & Maintenance | $500 | $500 | $500 | $500 | $500 | |
| - Depreciation | $1,000 | $980 | $980 | $980 | $980 | |
| - Stock Replacement Costs | $0 | $0 | $0 | $0 | $0 | |
| ***Total Fixed Costs*** | ***$1,500*** | ***$1,480*** | ***$1,480*** | ***$1,480*** | ***$1,480*** | $7,421 |
| | | | | | | |
| ***Total Operating Costs*** | ***$32,490*** | ***$85,648*** | ***$85,649*** | ***$85,649*** | ***$85,649*** | $375,085 |
| ***Total Operating Profit*** | ***$21,358*** | ***$15,760*** | ***$15,759*** | ***$12,759*** | ***$11,759*** | $77,395 |
| | | | | | | |
| *Capital Costs* | | | | | | |
| - Stock purchase Costs | $7,200 | | | | | |
| - Piggery Material Costs | $40,000 | | | | | |
| - Transport Costs of breeders to site | $0 | | | | | |
| - Piggery Construction Costs Costs | $10,000 | | | | | |
| ***Total Capital Costs*** | ***$57,200*** | ***$0*** | ***$0*** | ***$0*** | ***$0*** | $57,200 |
| | | | | | | |
| **TOTAL PROJECT COSTS** | **$89,690** | **$85,648** | **$85,649** | **$85,649** | **$85,649** | $432,285 |
| | | | | | | |
| **NET FARM INCOME** | **-$35,842** | **$15,760** | **$15,759** | **$12,759** | **$11,759** | $20,195 |
| | | | | | | |
| | | | | | | |
| **BENEFIT COST ANALYSIS** | | | | | | |
| **BENEFIT COST RATIO** (BCR) | **1:** | **1.05** | | 1.046716 | | |
| **NET PRESENT VALUE** (NPV) | **$8,296.85** | | | | | |
| **INTERNAL RATE OF RETURN** (IRR) | | | | | | |
| **(Using JP Gittingers formula)** | lower dic Rate | 8% | | | | |
| Economic Analysis of Agricultural Projects | Higher disc rate | 30% | | | | |
| | Difference | 22% | | | | |
| | NPV @ lower dic rate | $1,615.59 | | | | |
| | NPV @ higher dic rate | $6,058.44 | | | | |
| | sum of NPVs | $7,674.03 | | | | |
| | | | | | | |
| | **IRR** | **8.0%** | | | | |

Chapter 11

# FARM RECORDS





## 11.1 Keeping Farm Records

Measuring performance is very important in order to improve efficiency of farm production and profitability of farming business. This is why farmers need to keep records in order to determine cost of production and profit margins. Therefore, all farmers should make a habit of keeping all relevant records in relation to the production of different commodities in different parts or blocks of the farm. To know the financial position of a farm the farmer will need to prepare a profit and loss statement and keep and maintain a balance sheet of the farm to know his credit worthiness and net worth/equity. This is where all records related to income, expenditures, assets, and liabilities of the farm must be kept and updated at all times.

## 11.2 What is a record?

A record is a written proof of what happened, what is happening or what is anticipated to happen.

## 11.3 Why keeping records?

We keep records to help us remember all the activities undertaken in our farms on day to day basis, that will enable us to make sound business decisions based on verifiable data and records.

## 11.4 Advantage of keeping records

i. You will know how much you have received and how much money you have spent.

ii. You will know how much inputs and materials used to grow an enterprise.

iii. You will know the price of products sold and cost of inputs.

iv. You can calculated whether you are making a profit or a loss.

v. You will be able to make better decision on what to buy and what to sell.

vi. You can keep records of your accounts receivable and payables so that people cannot cheat you!

## 11.4 What Records Should be Taken?

Keeping records for the sake of keeping them is just a waste of time and energy. Farm Managers spend only a little time in keeping records. A little time spent in keeping good and informative records will generally assist in assessing the performance and the way forward for the farm business.

It is imperative that farmers or managers to have records of the following;

**i.** **Farm Diary** : A small notebook in which to record the key facts and figures of the farm business and the day to day activities.

**ii.** **Area Statement Records** : A farmer must know his total farm area and his area under production, utilization rate and efficiency of productivity per unit area (production parameters per unit area).

**iii.** **Crop Records**: It is imperative to keep records of all the activities undertaken on every crops over a period of time such as planting time, fertilizer application, labor inputs, visual impression of crops and harvesting.

**iv.** **Livestock Records**: The record will assist the farmer to know the herd performance and its profitability.

**v.** **Unit Costs:** of all major farm inputs such as fertilizer, fuel, water, feed concentrates and stock purchases. These are necessary for routine book keeping and also to monitor seasonal changes and to plan future procurement.

vi. **Unit returns** from all farm outputs such as milk, cull cow and heifers, sale steers or bulls, manure, excess feed, to plan future sales.

vii. **Livestock Inventory accounting**: The main purpose is to monitor net losses and gains in income, and to distinguish and to distinguish the increases and decrease due to changes in market value. When quantifying total livestock value you have to take into account both changing herd size and change in unit price.

viii. **Plant and improvement records:** The, a records include date and cost of purchase or installation, annual depreciation, insurance and registration, fuel use, hours use (to plan service), major repairs and maintenance.

ix. **Key financial** such as interest and principal repayment schedules to plan repayments.

x. Other key farm management records such as rates and government charges, other administrative costs such as telephone, laborer's wages, capital investments, unusual weather events, changes in valuation of capital items such as land and livestock categories.

xi. **Personal Expenses** to ensure the manager and farm family's wages are realistic and that the family member are living within their means. This should include a valuation of any farm produced used for personal consumption.

## 11.5 SIMPLE FARM RECORDS TEMPLATE

### 11.5.1 Area Statement Records

| AREA STATEMENT OF THE MONTH OF _____, 20_____ | | | | | |
|---|---|---|---|---|---|
| Name of Farmer : _____ | | | | Date : _____ | |
| Crops | Unit | Opening | New plant | Harvest | Closing |
| ***Cassava*** | | | | | |
| Mature | acre | | | | |
| Immature | acre | | | | |
| ***Dalo*** | | | | | |
| Mature | number | | | | |
| Immature | number | | | | |
| Vegetables | | | | | |
| Capsicum | acre | | | | |
| Cucumber | acre | | | | |
| Eggplant | acre | | | | |
| | | | | | |
| TOTAL | | | | | |

## 11.5.2 Crop Records

### a) Planting Record

| PLANTING RECORD | | | | | | |
|---|---|---|---|---|---|---|
| Date | Field No. | Crop | Area Planted (acre/ha)/Total Number of Plants planted | Expected Harvesting Time | Expected Yield (kg) | Remarks |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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### b) Fertilizer Record

| FERTILIZER RECORD | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Field No. | Crop | Area (acre/ha)/Total Number of Plants | Age of Crops | Types of Fertilizer | Recommended Application Rate (g/plant) | Total Quantity Applied | Remarks |
| | | | | | | | | |
| | | | | | | | | |
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| PESTICIDES RECORD | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Field No. | Crop | Area (acre/ha)/Total Number of Plants | Age of Crops | Types of Disease or Insect | Level of Infestation (%) | Name of Pesticide | Recommended Application Rate (g or ml/plant) | Total Quantity Applied (l or kg) | Remarks |
| | | | | | | | | | | |
| | | | | | | | | | | |
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| | | | | | | | | | | |

**c) Pesticides Record**

**d) Labour Record**

| LABOR RECORD | | | | |
|---|---|---|---|---|
| Date | Details of Activity | Total Number of Labors involved | Total Number of Hours | Total Labor Costs |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
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**e) Harvesting Record**

| HARVESTING RECORD | | | | | | |
|---|---|---|---|---|---|---|
| Date | Field No. | Crop | Area Harvested (acre/ha) OR No of Plants Harvested | Production (kg) | Amount Rejected (kg) | Remarks |
| 14.5.2012 | 2b | Cassava | 533 mounds | 40 x 40 bags | nil | order for Suva market |
| 16.5.2012 | 1a | Capsicum | 60 plants | 20kg | nil | order for MH Superfresh |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
| | | | | | | |
| | | | | | | |

| SALES RECORD | | | | | | |
|---|---|---|---|---|---|---|
| Date | Sales | Quantity | Market Outlet | Unit Price ($) | Total Income ($) | Remarks |
| 15.5.2012 | Cassava | 40 bags Cassava | Suva Market | $40/bag | $1,600 | Cash Sales |
| 17.5.2012 | Capsicum | 20 kg | MH Superfresh | $15/kg | $300 | Cash Sales |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**f) Sales Record** -The record details all sales and cash inflow to the farm business.

| EXPENSES RECORD | | | | | |
|---|---|---|---|---|---|
| **Date** | **Operation** | **Quantity** | **Unit Cost ($)** | **Total Costs ($)** | **Comments** |
| 10.10.2013 | Purchase of NPK | 10 x 40kg bags | $79.00/bag | 790 | Fertilizer was purchased from AgChem, Lami |
| 12.10.2013 | Purchase of Diesel | 1 Drum - 200 litres | $489/drum | 489 | Purchased from Total - Walu. |
| 30.10.2013 | Wages for Laborers | 3 Casuals | $20/day | 300 | Wages for 5 days - 26/10 - 30/10/2014 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**g) Expenses Record -** The record entails all the cash outflow from the farm business.

e) ***Home Consumption Record*** : The record entails all the crops being consumed by the household members. Keeping the record at farmer's level is imperative to enable the farmer to know his demand of food security with its tag value.

| Date | Consumed Item | Quantity | Unit Price ($) | Total Value ($) | Comments |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
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| | | | | | |

f) ***Profit & Loss Record*** **:** It reflects the past performance of the farm business and is the report most often used by small business owners to track the performance of the business. Having this record is vital since it measures the profit or loss of the farm business over a specified period of time. The profit and loss statement summarizes the income for a period and subtract the expenses incurred for the same period to calculate the profit or loss for the business.

**PROFIT & LOSS STATEMENT AS AT _____ 20___**

Name of Farmer : _____

| PARTICULARS | QUANTITY | UNIT PRICE ($) | TOTAL |
|---|---|---|---|
| ***Sales*** | | | |
| Dalo - Tausala | | | |
| Cassava | | | |
| ***Total Income (A)*** | | | |
| ***Variable Costs - (B)*** | | | |
| Planting Materials | | | |
| Fertilizer | | | |
| Pesticide | | | |

| | | | |
|---|---|---|---|
| Land Preparation<br>Labour | | | |
| ***Fixed Costs - ( C )*** | | | |
| Living Expenses | | | |
| Education | | | |
| Health | | | |
| Travelling | | | |
| Religious Obligation | | | |
| Social Obligation | | | |
| ***Total Costs (B + C = D)*** | | | |
| Profit/Loss (A-D) | | | |

***g) Assets Records :*** This record keeps a register of all procured assets with their purchased values and their expected useful life over the years before it is trade off.

| Date of Purchase | Item | Purchase Price ($) | Useful Life (Years) | Comments |
|---|---|---|---|---|
| | | | | |
| | | | | |
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### 11.5.3 Livestock Records

### 11.5.3.1 Dairy & Cattle

a) *Daily Milk Production Record*

| Week _____ of the Month of _____ 20_____ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **No** | **Cow Number** | **Day 1** | **Day 2** | **Day 3** | **Day 4** | **Day 5** | **Day 6** | **Day 7** |
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |

***b) Bang Tail Muster Record :*** This is a pre-requisite for Dairy and Beef farmers in conducting a 6 monthly bang tail muster and stock take that is needed to do a stock reconciliation report.

*BANG TAIL MUSTER RECORD (DAIRY & BEEF)* *Date :* _____

| Stock Number | STOCK CLASS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cow | Bull | H3 | H2 | H1 | S3 | S2 | S1 | H/C | B/C |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Total | | | | | | | | | | |

## *c) Stock Reconciliation Record*

*Reconciliation of the Month of _____ to the Month of 20_____*

| *Stock Class* | *Opening* | *Purchases* | *Birth* | *Transfer -In* | *Transfer Out* | *Sales* | *Deaths* | *Closing* |
|---|---|---|---|---|---|---|---|---|
| Milking Cows | | | | | | | | |
| Dry Cows | | | | | | | | |
| Heifer 3 | | | | | | | | |
| Heifer 2 | | | | | | | | |
| Heifer 1 | | | | | | | | |
| Steer 3 | | | | | | | | |
| Steer 2 | | | | | | | | |
| Steer 1 | | | | | | | | |
| Heifer Calves | | | | | | | | |
| Bull Calves | | | | | | | | |
| TOTAL | | | | | | | | |

## *d) Dairy Birth Register Record*

*DAIRY BIRTH REGISTER - MONTH OF _____ 2014*

| Date | Cow Number | Description | Male/Female | Birth Weight | Remarks |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
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### *d) Dairy Death Register Record*

| *DAIRY DEATH REGISTER - MONTH OF _____ 2014* | | | | | |
|---|---|---|---|---|---|
| Date | Stock Number | Stock Class | Male/Female | Reason of Death | Remarks |
| | | | | | |
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### *e) Sales Register Record*

| *SALES REGISTER - MONTH OF _____ 20 _____* | | | | | |
|---|---|---|---|---|---|
| Date | Stock Number | Stock Class | Receipt No. | Price ($) | Remarks |
| | | | | | |
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## BLOCK IDENTIFICATION

| *Pasture Matrix* | *Unit* | *Block 1* | *Block 2* | *Block 3* | *Block 4* | *Block 5* | *Block 6* | *Block 7* | *Block 8* | *Block 9* |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Pasture Type*** | | | | | | | | | | |
| ***Edible Species*** | | | | | | | | | | |
| Para Grass | % | | | | | | | | | |
| Batiki Blue | % | | | | | | | | | |
| Signal Grass | % | | | | | | | | | |
| Setaria | % | | | | | | | | | |
| Elephant Grass | % | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Siratro | % | | | | | | | | | |
| Desmodium | % | | | | | | | | | |
| Navua Sedge | % | | | | | | | | | |
| Legumes | % | | | | | | | | | |
| Guinea Grass | % | | | | | | | | | |
| ***Weeds*** | | | | | | | | | | |
| Hibiscus Bur | % | | | | | | | | | |
| Yellow Primrose | % | | | | | | | | | |
| Prickly Solanum | % | | | | | | | | | |
| | | | | | | | | | | |
| ***Effective Pasture*** | % | | | | | | | | | |
| ***Area of Block*** | ***ha*** | | | | | | | | | |
| ***Dry Matter/ha of Effective Pasture*** | ***tonnes dm/ year*** | | | | | | | | | |
| ***Feed Availability*** | ***kg*** | | | | | | | | | |
| | | | | | | | | | | |
| ***Current Carrying Capacity in Stock Units*** | | | | | | | | | | |
| ***Potential Carrying Capacity*** | | | | | | | | | | |

***f) Production of Pasture Record :*** The farmer will need to keep a record of existing pastures detail in the pasture as shown below. This will help him the carrying capacity of existing pasture and determine the potential carrying capacity of improved pasture that should match the feed demand shown in the Stock Reconciliation Matrix of the farm. Details of pasture performance that could be used in Feed Budgeting is shown in Chapter 4.

### 11.5.3.2 Swine Records

*a) Stock Reconciliation Record*

| RECONCILIATION OF THE MONTH OF _____ TO THE MONTH OF _____ 20 _____ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Stock Class | Opening | Purchases | Births | Transfer - In | Transfer Out | Sales | Deaths | Closing |
| Sow | | | | | | | | |
| Gilts | | | | | | | | |
| Porkers | | | | | | | | |
| Weaners | | | | | | | | |
| Piglets | | | | | | | | |
| Boar | | | | | | | | |
| | | | | | | | | |

*b) Birth Register Record*

| *SWINE BIRTH REGISTER - MONTH OF _____ 2014* | | | | | |
|---|---|---|---|---|---|
| Date | Sow Number | Description | Male/Female | Birth Weight | Remarks |
| | | | | | |
| | | | | | |
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| | | | | | |

c) Death Register Record

| *SWINE DEATH REGISTER - MONTH OF _____ 2014* | | | | | |
|---|---|---|---|---|---|
| Date | Stock Number | Stock Class | Male/Female | Reason of Death | General Remarks |
| | | | | | |
| | | | | | |
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| | | | | | |
| | | | | | |

**d) Sales Register Record**

| *SALES REGISTER - MONTH OF _____ 20 _____* | | | | | |
|---|---|---|---|---|---|
| Date | Stock Number | Stock Class | Receipt No. | Price ($) | Remarks |
| | | | | | |
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11.5.3.3 Sheep Record

a) Stock Reconciliation Record

| RECONCILIATION OF THE MONTH OF _____ TO THE MONTH OF _____ 20 _____ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Stock Class | Opening | Purchases | Births | Transfer - In | Transfer Out | Sales | Deaths | Closing |
| Ewe | | | | | | | | |
| Ram | | | | | | | | |
| Ram Hogget | | | | | | | | |
| Ewe Hogget | | | | | | | | |
| Ram Lamb | | | | | | | | |
| Ewe Lamb | | | | | | | | |
| | | | | | | | | |

| *SHEEP BIRTH REGISTER - MONTH OF _____ 2014* | | | | | |
|---|---|---|---|---|---|
| Date | Ewe Number | Description | Male/Female | Birth Weight | Remarks |
| | | | | | |
| | | | | | |
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**b)** ***Birth Register Record***

c) Death Register Record

| *SHEEP DEATH REGISTER - MONTH OF _____ 2014* | | | | | |
|---|---|---|---|---|---|
| Date | Stock Number | Stock Class | Male/Female | Reason of Death | General Remarks |
| | | | | | |
| | | | | | |
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| | | | | | |
| | | | | | |

***d) Sales Register***

| *SALES REGISTER - MONTH OF _____ 20 _____* | | | | | |
|---|---|---|---|---|---|
| Date | Stock Number | Stock Class | Receipt No. | Price ($) | Remarks |
| | | | | | |
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# APPENDIX 1

# CLIMATE CHANGE & METEOROLOGICAL DATA

## A. *Climate & Climate Variability*

Climate Change is a wide addressed phenomenon around the globe. It refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate Change may be due to natural internal processes or external forcing, or to persistent man made changes in the composition of the atmosphere or in land use. It is becoming increasingly clear that climatic variations are influenced not only by natural forces, but by human activities as well. This human component is believed to be responsible for climate change and global warming, which is expected to interact with the natural component in a largely unknown way.

### Explanation of Some Terms & Concepts

### *i. Climate & Climate Variability*

Climate system means the totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions. Variation in climate is one of the main determinants of Agricultural production in all countries.

Climate in a narrow sense is usually defined as the average weather or more rigorously, as the statistical description in terms of the marn and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years. These quantities are most often surface variables such as temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description of the climate system.

It includes seasonal extremes and variations, either locally, regionally or across the globe.

In contrast to weather, climate is generally influenced by slow changes in features like the ocean, the land, the orbit of the Earth around the Sun, and the energy output of the Sun.

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability) or to variations in natural or anthropogenic external forcing (external variability).

### *ii. Agro-meteorology*

Agro-meteorology deals with all the weather sensitive elements of Agriculture production. The spectrum of subjects is thus rather wide. It includes pollination, animal migration, human and animal health, transport of pathogens by wind, irrigation, micro climate, manipulation and artificial climate, weather risks assessments, the use of weather forecast in farming, crop yield and phenology forecasts and particularly advice to farmers. Current agro-meteorology relies on a package of new tools, which define modern agro-meteorology. They include data acquisition techniques, (ground observation, aircraft and satellite), data transmission techniques (including the internet) and data analysis ( model and software).

### *iii. Climate Monitoring*

Weather forecasts provide information about the weather expected over the next few days.

### *iv. El Niño Southern Oscillation*

Niño is a local warning of surface waters which takes place in the entire equatorial zone of the Central and Eastern Pacific Ocean off the Peruvian coast and which affects the atmospheric circulation world - wide.

### *v. Crop Monitoring & Forecasting*

Analysis of meteorological and climatic data allows to provide near real time information about the crop state, in quality with the possibility of early warning on alarm/alert situations so that timely interventions can be planned and undertaken.

### *vi. Advice and Warnings*

Agro-meteorological and remotely sensing data can provide information in respect of a wide range of applications such as :

a) Estimation of potential productivity of a region and comparison with the actual productivity;

b) Inventory of natural resources such as length of growing period, water availability, water, solar and wind energy, biomass and their spatial and temporal variability;

c) Identification of new crop management techniques and agro-meteorological strategies for improved application of information on the climatic factors and their annual variability;

d) Planning land management projects on the basis of climate and soil patterns to improve utilisation of natural resources, limit the constraints of adverse conditions and

e) Planning of farm practices.

Agrometeorological information, used for decision making, represents part of the

continuum that begins with scientific knowledge and understanding, and ends with evaluation of information.

### *vii. Food Security*

At the World Summit in Rome (1996), food security was defined as the situation, when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Since 1970, FAO has been very active in supporting the establishment, improvement and reinforcement of national food information systems, which are the main structure of food security monitoring. Food Security depends on many factors but weather variability plays a significant part.

### *viii. Crop Insurance*

Crop insurance is normally purchased by farmers to protect themselves against crop failures due to natural disasters such as floods, hail and drought. It may also be subsidized by the Government.

### *ix. Importance of Biodiversity for Food & Agriculture*

Biodiversity provides the raw materials, the combinations of genes, which produce the plant varieties and animal breeds upon which agriculture depends. Climate change threatens biodiversity and impacts ecosystem functions, including those important for food supply. By the end of the century, climate change is expected to be the main driver of biodiversity. Then, the resilience of many ecosystem is likely to be exceeded resulting from changes in climate and associated disturbances (e.g drought, fire, pests, ocean acidification) and other global change drivers. These trends could exacerbate the vulnerability of millions of people who are already food insecure and have a low capacity to adapt to the changing conditions.

On the other hand, biodiversity in all its components (e.g genes, species, ecosystems) increases resilience to changing environmental conditions and stresses. Thus, the value of genetically-diverse populations and species- rich natural and agricultural ecosytems will increase in future with the need for adaptation to climate change.

### *x. Climate Change & Agriculture*

Agriculture is highly exposed to climate change as farming activities directly depend on climatic conditions but also contributes to the release of greenhouse gases to the atmosphere. However, agriculture can help to provide solutions to the overall climate change problem. Agriculture is a source of and also a solution to Climate Change!

If adequate sustainable production measures are adopted that hold substantial mitigation potential, and that contributes to adapt agriculture and food production systems to extreme events, raising temperatures and increasing $CO^2$ concentration.

### *xi. Adaptation to Climate Change*

Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

The knowledge and technology required for the adaptation includes understanding the patterns of variability of current and projected climate, seasonal forecasts, hazard impact mitigation methods, land use planning, risk management and resource management. Adaptation practices requires extensive high quality data and information on climate, and on agricultural, environmental and social systems affected by climate, with a view to carrying out realistic vulnerability assessment and looking towards the near future.

Vulnerability assessment observes impacts of variability and changes in mean climate (inter annual and intra-seasonal variability) on Agricultural systems.

To adapt to Climate Change farmers will need to broaden their genetic base and use new cultivars and crop varieties. They will need to adopt sustainable agronomic practices such as shift in sowing/planting dates, use of cover crop, live mulch and efficient management of irrigation, and reduce the vulnerability of soil based agricultural production systems through the management of soil fertility, reduced tillage practices and management of the cycle of soil organic carbon more efficiently in grasslands and cropping systems. There will be a need to monitor pathogens, vectors and pests and assessing how well natural population control is working.

B. **How farming can adapt to the changed climate?**

To cope with projected climate change, farmers can;

a) Change their crop rotation to make the best use of available water.

b) Adjust sowing dates according to temperature and rainfall patterns.

c) Use crop resistant varieties better suited to new weather conditions (e.g. more resilient to heat and drought),

d) Plant hedgerows or small wooded areas on arable land to reduce water run offs and acts as a wind breaker.

Generally, it is through the establishment of sustainable of **Farming Systems Development (FSD)** that will mitigate the impact of Climate Change.

However, farmer cannot shoulder the burden alone. Public policy must support farmers by:

a) Helping them adapt farm structures and production methods,

b) Helping them continue to provide services for the rural environment,

c) Keeping the community well informed about climate risk,

d) Adapting options to the farming community,

e) Providing advisory services and training.

The reformed rural development policy will be important in an adaptation strategy for Agriculture. Future agriculture reforms will have to take into account of adaptation needs, so farmers can continue managing their business in a sustainable manner, ensuring the provision of public benefits such as sustaining rural communities and maintaining rural landscapes.

## METEOROLOGICAL DATA

| | | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Koronivia | Maximum Temp (°C) | 2010 | 30.7 | 30.8 | 30.2 | 29.7 | 29.7 | 29.1 | 26.7 | 28.2 | 28.4 | 28.5 | 28.6 | 30.2 |
| | Minimum Temp (°C) | 2010 | 23.7 | 23.9 | 23.7 | 22.8 | 23 | 22.6 | 19.8 | 20.7 | 21.8 | 21.6 | 22.4 | 22.8 |
| | Rainfall (mm) | 2010 | 82.3 | 250.9 | 402.5 | 402.4 | 212.9 | 87.7 | 154.8 | 184 | 70.9 | 495.4 | 616.7 | 230.5 |
| | Relative Humidity (%) | 2010 | 75 | 78 | 82 | 84 | 82 | 84 | 80 | 78 | 77 | 78 | 82 | 78 |
| | Sunshine (Hours) | 2010 | 161.1 | 179 | 104.7 | 104.7 | 89.1 | 114.6 | 89.6 | 196 | 192.6 | 122.2 | 82.8 | 167.1 |
| | Maximum Temp (°C) | 2011 | 30.6 | 30.6 | 31.3 | 31.2 | 29.9 | 29.5 | 28.2 | 27.2 | 27.8 | 29.1 | 29.2 | 30.8 |
| | Minimum Temp (°C) | 2011 | 23.4 | 23 | 23 | 23.2 | 22.5 | 21.4 | 20.8 | 20.2 | 21 | 22 | 23.1 | 22.9 |
| | Rainfall (mm) | 2011 | 208.4 | 183.7 | 311.1 | 216.2 | 347.1 | 329.7 | 221.5 | 62.6 | 92.1 | 325.7 | 364.8 | 404.9 |
| | Relative Humidity (%) | 2011 | 82 | 81 | 80 | 81 | 83 | 83 | 83 | 77 | 76 | 76 | 76 | 77 |
| | Sunshine (Hours) | 2011 | 180 | 164.6 | 184 | 142.7 | 109.6 | 125.7 | 81.2 | 85.2 | 85 | 93.1 | 107.6 | 165.5 |
| | Maximum Temp (°C) | 2012 | 30.3 | 30.3 | M | 30.3 | 28.9 | 27.9 | 27.2 | 27.6 | 27.5 | 29.6 | 29.3 | 30.9 |
| | Minimum Temp (°C) | 2012 | 23.7 | 23.2 | 23.5 | 23.1 | 21.6 | 20.3 | 20.5 | 21.5 | 21.1 | 22.2 | 22.1 | 23.1 |
| | Rainfall (mm) | 2012 | 328.6 | 344 | 471.6 | 305.6 | 219.6 | 207.9 | 188.1 | 99.3 | 226.2 | 264.8 | 183.4 | 171.3 |
| | Relative Humidity (%) | 2012 | 81 | 82 | 84 | 82 | 82 | 81 | 81 | 80 | 80 | 76 | 76 | 72 |
| | Sunshine (Hours) | 2012 | 101 | 116.1 | M | 127 | M | M | 115.9 | 116.4 | M | M | 64.6 | M |

| | | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nacocolevu | Maximum Temp (°C) | 2010 | M | M | M | M | M | M | 28.2 | 30 | 30.7 | 29.6 | 29.6 | 31.1 |
| | Minimum Temp (°C) | 2010 | M | M | M | M | M | M | M | M | 19.9 | 20.7 | 21.7 | 22 |
| | Rainfall (mm) | 2010 | M | M | M | M | M | M | 12.5 | M | 18.7 | 66.8 | M | M |
| | Relative Humidity (%) | 2010 | M | M | M | M | M | M | 82 | 79 | 72 | 74 | 82 | 82 |
| | Maximum Temp (°C) | 2011 | 31.1 | 31.8 | 31.1 | 30.5 | 30.4 | 30 | M | M | 28.7 | 29.6 | 30.3 | 31.5 |
| | Minimum Temp (°C) | 2011 | 22 | M | M | 22.1 | 21.6 | 20.3 | M | M | 19.2 | 21.1 | 22.1 | 22.1 |
| | Rainfall (mm) | 2011 | 130.4 | 236.2 | 253.1 | 354 | 202.2 | 125.4 | M | M | M | 218.8 | M | 487.2 |
| | Relative Humidity (%) | 2011 | 87 | 87 | 86 | 87 | 88 | 90 | M | M | 84 | 81 | 82 | 83 |
| | Maximum Temp (°C) | 2012 | 30.6 | 30.7 | 31.7 | 31.5 | 28.3 | M | 27.4 | 28.6 | 28.5 | 30.6 | M | M |
| | Minimum Temp (°C) | 2012 | 23 | 22.7 | 22.7 | 21 | 18.5 | M | 18.2 | 18 | 18.8 | 20.6 | M | M |
| | Rainfall (mm) | 2012 | M | 293.5 | 439 | 246.7 | 104.2 | M | 28 | M | M | M | M | M |
| | Relative Humidity (%) | 2012 | 88 | 88 | 87 | 84 | 83 | M | 88 | 90 | 89 | 80 | M | M |

| | | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WAINIGATA | Maximum Temp (°C) | 2010 | 30.5 | 31.2 | 30.9 | 30.8 | 30.3 | 29.7 | 28.1 | 28.9 | 29.2 | 29.6 | 29.3 | 30.3 |
| | Minimum Temp (°C) | 2010 | 24 | 23.8 | 23.4 | 22.4 | 23.2 | 22.5 | 21.4 | 20.2 | 21.6 | 22 | 22.4 | 22.3 |
| | Rainfall (mm) | 2010 | M | M | 243.5 | 307.3 | 107.8 | 148.1 | M | 3.6 | M | M | M | 349.4 |
| | Relative Humidity (%) | 2010 | M | M | 81 | 81 | M | M | M | M | M | M | M | M |
| | Maximum Temp (°C) | 2011 | 30.4 | M | 31.3 | M | 29.9 | 29.9 | 29 | 28.2 | 28.7 | 29.6 | 29.7 | 31 |
| | Minimum Temp (°C) | 2011 | 22.5 | M | 22.1 | M | 22 | 21.4 | 21 | 20.8 | 21.6 | 22.3 | 22.8 | 22.1 |
| | Rainfall (mm) | 2011 | 207.5 | M | M | M | M | 185.7 | 180.4 | 183.1 | 133.7 | 129 | M | 210.2 |
| | Relative Humidity (%) | 2011 | M | M | M | M | 82 | 78 | 77 | 75 | 78 | 79 | 82 | 77 |
| | Maximum Temp (°C) | 2012 | 31 | 30.6 | 30.7 | 30.1 | 28.9 | 28.1 | 28 | 28.2 | M | 29.5 | 29.8 | 30.9 |
| | Minimum Temp (°C) | 2012 | 22.6 | 22.6 | 22.6 | 22.9 | 22.6 | 20.8 | 20.4 | 20.4 | M | M | 23.1 | 23.4 |
| | Rainfall (mm) | 2012 | 342.2 | 537 | 356.9 | 247 | 259.9 | 99 | 42.4 | 133.1 | M | 351.4 | 250.2 | M |
| | Relative Humidity (%) | 2012 | 81 | 78 | 80 | 80 | 78 | 74 | 74 | 77 | M | 78 | 77 | 79 |
| | Maximum Temp (°C) | 2013 | 31.4 | M | 30.4 | 30.8 | 30.1 | 29.3 | 28.1 | 28.6 | M | 29.1 | M | M |
| | Minimum Temp (°C) | 2013 | 23.3 | M | 23.4 | 23 | 22.4 | 22.2 | 21.1 | 22.1 | M | 21.9 | M | M |
| | Rainfall (mm) | 2013 | 180.1 | 449.8 | M | M | 258.5 | M | 70.5 | 90.1 | M | 139.6 | M | M |
| | Relative Humidity (%) | 2013 | 78 | M | 84 | 79 | 78 | 81 | 78 | 79 | M | 76 | M | M |

| | | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DOBUILEVU | Maximum Temp (°C) | 2010 | 31.6 | M | 31.9 | 30.4 | 29.9 | 29.5 | 27.6 | 29.6 | 30.4 | 29.7 | 29.6 | 30.9 |
| | Minimum Temp (°C) | 2010 | 23.8 | M | 22.5 | 22.3 | 22.5 | 21.3 | 18.5 | 18.7 | 20.9 | 21.2 | 22 | 22.3 |
| | Rainfall (mm) | 2010 | M | M | 160.3 | M | 83.1 | M | M | 35.7 | M | M | 816.5 | M |
| | Relative Humidity (%) | 2010 | 85 | M | 90 | 88 | 85 | 88 | 81 | 81 | 78 | 80 | 82 | 82 |
| | Sunshine (Hours) | 2010 | M | M | M | M | M | M | M | 203.6 | M | M | M | M |
| | Maximum Temp (°C) | 2011 | 30.5 | 30.6 | 31.5 | 31.1 | 30.2 | M | 28.9 | 27.7 | 28.4 | 29.8 | 29.9 | 31.4 |
| | Minimum Temp (°C) | 2011 | 22.5 | 22.2 | 22.3 | 22.2 | 22.3 | M | 19.8 | 19.7 | 20.5 | M | M | 22.2 |
| | Rainfall (mm) | 2011 | M | 473.6 | 212.1 | 137.8 | 205.6 | M | M | M | 127 | M | 469.9 | 226.7 |
| | Relative Humidity (%) | 2011 | 87 | 87 | 85 | 88 | 89 | M | 83 | 82 | 80 | 80 | 85 | 80 |
| | Sunshine (Hours) | 2011 | M | 130.6 | M | M | M | M | M | M | 93.1 | M | M | M |
| | Maximum Temp (°C) | 2012 | 31.4 | 30.7 | 31.6 | 30.6 | 28.6 | 28.2 | 27.2 | 28.4 | 28.8 | 30.5 | 30.6 | 32 |
| | Minimum Temp (°C) | 2012 | 23 | 21.9 | 22.6 | 22.2 | 20.1 | 19 | 19.4 | 19.4 | 20.5 | 21.3 | 21.5 | 22.4 |
| | Rainfall (mm) | 2012 | M | 458.6 | 719.8 | 193.2 | 56.8 | 185.9 | M | 21.3 | 151.5 | M | 84 | 577.8 |
| | Relative Humidity (%) | 2012 | 85 | 85 | 83 | 86 | 85 | 86 | 85 | 88 | 87 | 80 | 84 | 87 |
| | Sunshine (Hours) | 2012 | M | 113.5 | M | M | 115.9 | M | M | M | M | M | M | M |
| | Maximum Temp (°C) | 2013 | 32.2 | 31.4 | 30.7 | 31.1 | 29.4 | 28.9 | 27.3 | 28.8 | M | M | 31.5 | 31.4 |
| | Minimum Temp (°C) | 2013 | 22.7 | 22.4 | 22.4 | 21.9 | 20.8 | 20.4 | 19.4 | 20.4 | M | M | 21.8 | 21.6 |
| | Rainfall (mm) | 2013 | 210.8 | 348 | 271.9 | M | M | 200.4 | 99 | 54.8 | M | M | 99.4 | 86.7 |
| | Relative Humidity (%) | 2013 | 76 | 82 | 86 | 85 | 87 | 86 | 87 | 79 | M | M | 80 | 82 |
| | Sunshine (Hours) | 2013 | 178.5 | M | 113.4 | 142.3 | 136.3 | 130 | 133.9 | M | M | M | 127 | M |

| | | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Legalega Research | Maximum Temp (°C) | 2010 | 32.7 | 33.3 | 32.1 | 31.6 | 31.3 | 31.5 | 30.4 | 31.3 | 32.4 | 31.8 | 31.2 | 31.6 |
| | Minimum Temp (°C) | 2010 | 22.9 | 23.1 | 23 | 22.5 | 21.6 | 20.6 | 18.3 | 18.9 | 19.4 | 21.5 | 22.1 | 21.8 |
| | Rainfall (mm) | 2010 | 94.6 | 98.5 | 108.1 | 133.6 | 37.3 | 1.8 | 30.4 | M | 1.4 | 80.5 | 241.5 | 286 |
| | Relative Humidity (%) | 2010 | 66 | 68 | 73 | 77 | 71 | 69 | 63 | 63 | 60 | 60 | 72 | 68 |
| | Maximum Temp (°C) | 2011 | 32.2 | 31.5 | 31.9 | 31.5 | 31.5 | 31 | 31.4 | 29.6 | 30.1 | 31.1 | 32.1 | 32 |
| | Minimum Temp (°C) | 2011 | 22.2 | 22.1 | 22.4 | 22.9 | 21.4 | 19.8 | 19.3 | 19.3 | 20.2 | 21.6 | 22.1 | 22.1 |
| | Rainfall (mm) | 2011 | 355.2 | 264.3 | 332.4 | 269.4 | 193.9 | 92.8 | 113.9 | 83.4 | 60.4 | 160.1 | 218 | 282.2 |
| | Relative Humidity (%) | 2011 | 74 | 73 | 76 | 76 | 75 | 75 | 75 | 74 | 70 | 69 | 68 | 69 |
| | Maximum Temp (°C) | 2012 | 32.5 | 30.7 | 32.6 | 32.3 | 30.5 | 29.3 | 28.2 | M | 30.6 | 31.4 | 31.7 | 32.7 |
| | Minimum Temp (°C) | 2012 | 22.4 | 23.2 | 22 | 21.6 | 19.9 | 18.9 | 17.9 | M | 20.5 | 21.1 | 22 | 22.3 |
| | Rainfall (mm) | 2012 | 995.8 | 513.1 | 334.5 | 564.3 | 36.2 | 305.5 | 12.2 | M | 205.9 | 199 | 145.4 | 231.4 |
| | Relative Humidity (%) | 2012 | 75 | 78 | 75 | 74 | 74 | 76 | 72 | M | 74 | 71 | 66 | 68 |
| | Maximum Temp (°C) | 2013 | 32.5 | 31.5 | 31.5 | 32.3 | 30.8 | 31 | 30.3 | 30.7 | 30.7 | 30.6 | 32.7 | M |
| | Minimum Temp (°C) | 2013 | 23.3 | 22.3 | 23.3 | 21.3 | 21.6 | 21 | 19.1 | 19.3 | 19.2 | 20.8 | 22.9 | M |
| | Rainfall (mm) | 2013 | 83.1 | 460.4 | 265.2 | 80 | 27.2 | 117.1 | 5.6 | 16.2 | 141.1 | 112.5 | 301.9 | M |
| | Relative Humidity (%) | 2013 | 70 | 79 | 79 | 74 | 71 | 76 | 71 | 69 | 65 | 67 | 68 | M |

| | | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nawaicoba | Maximum Temp (°C) | 2010 | M | M | M | 30.9 | M | 30.6 | 28.5 | 30.5 | 31.6 | 31.2 | 30 | M |
| | Minimum Temp (°C) | 2010 | M | M | M | 21.7 | M | 20.7 | 17.5 | 20.3 | 19.5 | 19.8 | 21 | M |
| | Rainfall (mm) | 2010 | M | M | M | 168.3 | M | 2.6 | 139.8 | 2 | 1.6 | 236 | 413.4 | M |
| | Relative Humidity (%) | 2010 | M | M | M | 78 | M | 73 | 56 | 62 | 62 | 66 | 76 | |
| | Maximum Temp (°C) | 2011 | M | 30.6 | 30.7 | 27.5 | 30.1 | 29.8 | 29.8 | 28.5 | 29.6 | M | 30.5 | M |
| | Minimum Temp (°C) | 2011 | M | 22.4 | 22.4 | 22.4 | 22.1 | 20.4 | 19.9 | 19 | 20.1 | M | 22 | M |
| | Rainfall (mm) | 2011 | M | 420.2 | 372.5 | 340.8 | 287 | 91.5 | 73.4 | 101 | 55.2 | M | 295.9 | M |
| | Relative Humidity (%) | 2011 | M | 76 | 79 | 78 | 74 | 68 | 70 | 63 | 65 | M | 73 | M |
| | Maximum Temp (°C) | 2012 | M | 29.6 | 31 | 29.9 | 28.9 | 28.6 | M | 28.7 | 29 | M | 30.5 | M |
| | Minimum Temp (°C) | 2012 | M | 22.7 | 22.4 | 21.2 | 17.2 | 19.2 | M | 18.7 | 19.8 | 20.4 | M | M |
| | Rainfall (mm) | 2012 | M | 656.2 | 335.4 | 440.8 | 30.2 | 234.1 | M | 64 | 210.6 | 52.1 | M | M |
| | Relative Humidity (%) | 2012 | M | 77 | 79 | 72 | 67 | 65 | M | 60 | 63 | 68 | M | M |
| | Maximum Temp (°C) | 2013 | M | 30.6 | 30.3 | 31.2 | 29.9 | 29.1 | 28.1 | M | M | M | M | M |
| | Minimum Temp (°C) | 2013 | M | 22 | 22.9 | 21.6 | 20 | 19.5 | 19.7 | M | M | M | M | M |
| | Rainfall (mm) | 2013 | M | 496.3 | 381 | 88.9 | 92.1 | 94.3 | 15.8 | M | M | M | M | M |
| | Relative Humidity (%) | 2013 | M | 78 | 81 | 77 | 79 | 80 | 77 | M | M | M | M | M |

**(Source - Fiji Meteorological Office, Nadi, Fiji, 2014)**

APPENDIX 2A

# FARMING SYSTEMS DEVELOPMENT (FSD)





## FARMING SYSTEMS DEVELOPMENT (FSD)

FSD starts with the understanding of the whole farm household system, analyses all constraints and potentials, identifies appropriate research priorities and necessary institutional and policy changes, tests these on the farm, or stimulates its effects by modeling in case of policy changes. It then analyses all actual effects on the whole farm household system and on other interlinked systems, feeds the results back, to start again at the whole farm-household system.

The main thrust of FSD is, therefore to identify all major constraints that hamper the development of the farm household system and to specify and test possible solutions, both technical (from existing research results) and institutional. These solutions will usually include several components, for improving whole farm systems. FSD will identify the associated problems of credit, appropriate crop varieties, crop protection, storage, relevant pricing, extension and the mean of hedging increased risks. Also, labour may be a limiting factor, or there may be indirect effects on livestock, for example, through greater availability of crop residues.

FSD recognizes that the systems operated by small farmer are not only complex but they are also affected by many factors both internal to the farm household (eg. resources, culture) and external (eg. input suppliers, credit, markets). Only by close examination of the farmer's total situation, can real and comprehensive improvements be identified and implemented successfully.

**The Concepts of Farming Systems Development and Farm Household Systems**

***Long Term Development of FSD***

- To develop farm household systems and rural communities on a sustainable basis.

***Immediate Development Objective of FSD***

- To improve farm productivity;
- To raise farm and family income;
- To increase welfare of farm families and satisfy basic needs.

***How to achieve the FSD Objectives***

Meeting the above objectives requires a knowledge and understanding of the farm household systems. This is generated through the following two (2) main activities of FSD.

The two (2) main objectives of FSD are:

A. FARMING SYSTEMS ANALYSIS

- views the farm household system as a whole, and understand the connections and interactions between individual components.
- understands the natural, socio-cultural and policy institutional environments that

influence decision processes at farm household level.

- diagnose constraints to increased farm production and productivity as well as standard of living.
- identifies and assesses potential improvements
- orientates research, extension, support services or policy makers according to results of FSA.

B. FARMING SYSTEMS PLANNING, MONITORING AND EVALUATION

- tests, monitors and evaluates improvements on farm.
- plans appropriate improvements in farm household systems.
- disseminates successful practices through extension.
- plans adjustments in support services, research and extension strategies and policy programs.
- monitors and evaluates rate of adoption of proposed improvements by the farming community, which is the ultimate success criteria for the approach.

Both main FSD activities stress a practical approach based on a systems theory. Therefore, it is necessary to understand the basic characteristics of a systems approach.

***Systems Theory***

- Emphasize the need to view a situation as a whole, and not as separate parts. The boundaries of systems change with change in focus.
- Recognizes interactions of components, in the process of transforming inputs to outputs.
- Stresses systems hierarchy, whereby every smaller system is part of a larger system and itself consists of sub systems.

***FSD System's Focus***

- FSD focuses on the farm households system as the basic unit for analysis and development.

***Why Focus on Farm-Household System***

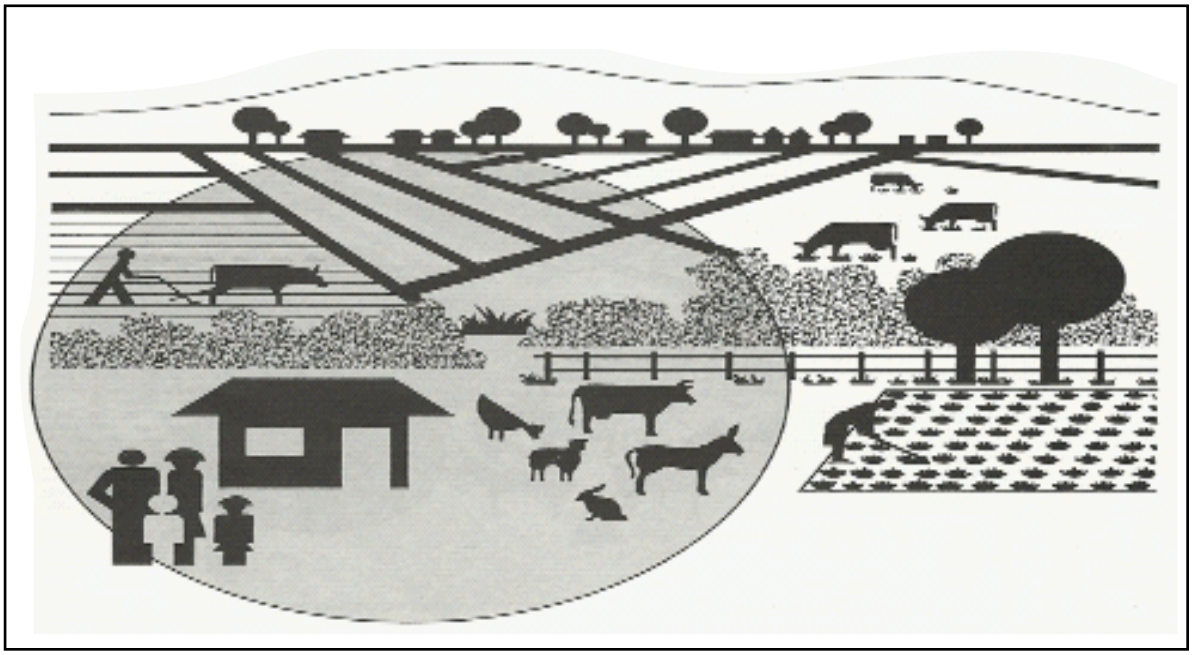
IF principle, any system analysis can be initiated at any level in the hierarchy of systems and sub systems.

FSD initiates its analysis at the farm household level because, in developing countries, the farm household is the decision making unit which ultimately controls the transformation of inputs into basic agricultural outputs (production).

At low level of development, the farm household linkages with higher systems are absent or minimal. At this level, the objectives of the farm-household are set by and for the farm-household itself. It is therefore important that the farm household objectives, and the way they try to achieve them, is well understood. In most cases, proposed intervention packages at the farm-household level will increase the linkages with other systems. This may lead to conflicting objectives.

With development, the level of independence decreases and the linkages with other systems become more important. The farm household becomes more important in fulfilling of the

objectives of systems higher up in the hierarchy. An important aspect of FSD is that it tries to identify where conflicting objectives and goals exist or may arise.



For example, a country has as one of its objectives to increase the marketable surplus of the country's main staple food to supply the urban people and cheaper food. This national objective must be translated into an action plan that actually motivates the farm households to produce more. If the government prepares an action program without consultation and without understanding the way the farm-household systems operate, the farm households may not be able or willing to produce more. In other words the farm-household sticks to its own objectives.

***What is a Farm Household System***

The farm household is the principal system and focus of FSD. It consists of three (3) basic sub systems, which are closely interlinked and interactive:

1. The household, decision making unit; establishing goals for the system; controlling the system; providing labour; demanding food and cash in fulfillment of set objectives.

2. The farm and its crop and livestock activities; providing employment, food and cash for the family;

3. The off farm component, competing with farm activities for labour; providing employment and income generating activities; becoming increasingly more important to supplement the well being of farm families.

***Basic Characteristics of Farm Household System***

- Farm-household systems are complex and reflect the multiple objective of the people concerned.
- Farm-household systems are dynamic and have developed over time in response to changes in the natural and socio economic environment.
- Farm-household systems incorporate a wealth of indigenous knowledge.
- Farm household systems can be modified, since rural people behave rationally and are receptive to change.

*Implications*

- The approach to develop farm-household systems must be based on a thorough analysis of all their elements.
- The approach must be creative, informal, cost and time effective, and should stress the understanding of systems inter relationships.
- The approach must be multi disciplinary in order to cover the complexity of the systems.
- The approach must involve an understanding of the dynamic processes causing changes in the systems.
- The approach must be participatory i.e. involving farm families and rural communities in the analysis of their existing systems and in the planning of improvements.

APPENDIX 2B

# FARMING SYSTEMS ANALYSIS & CHECKLIST FOR FARM REPORTING

## 1.0 FARMING SYSTEMS ANALYSIS AND CHECKLIST FOR FARM REPORTING.

The Farm Management Budget Manual is to be used by Extension officers to compile a proposed farm plan for a new farm or a Better Farm Plan for an existing farmer. The first part of farm reporting which is universally acceptable is to do a property report followed by the management report and then the Better Farm Plan for an existing farmer appraisal or a Proposed Farm Plan for a new farmer. This is basically a resource inventory taking stock of available resources like land, labor, and capital. This phase will require the appraiser to analyze the features and relevance of the resources and determine their limitations and potential. Are the resources used in the best manner or could it be used for something better. This format is consistent with FAO and international standard of Farm Reporting and is recommended for adoption in Fiji.

The use of farming systems analysis data in determining government interventions or projects for the farmers in the production and marketing phase makes this reporting a very critical one for the Ministry of Agriculture.

### 1.1 PREPARATION OF PROPERTY REPORTS

**I. Basic Information**

1. Reporter's name
2. Date of visit
3. Name, address and phone number of farmer
4. Legal and organizational structure of farm
5. Personal information about farmer – age bracket, education,

Family

**Aims and Objectives of Farmer**

5.1. Appraisal of farmer's emphasis on profitability, way of life, capital gain etc.

5.2. Farmer's attitude to risk, debt, new ideas, suggestions for change etc.

5.3. Family living expenses related to farm earnings

5.4 List farmers personal goals in the long term ,medium term and short term. Match his personal goals with business goals.

6. Based on Farm records appraise the resources and related constraints.

**II. Resources and Constraints**

***1. Land***

(a) Farm area, tenure, location, access, etc.

(b) Soils and topography - related to present and potential uses

(N.B. Obtain a land use capability and land classification from the Land Use Section to verify your plan and prepare or sketch a farm map.)

(c) Climate - rainfall, frosts, droughts, etc Analyze the climatic suitability in relation to the existing or chosen crops.

(d) Weeds, pests and diseases – Describe current weeds and pests and relate it to farmers practices.

(e) Crop rotations - What is the rotational policy.

***2. Improvements***

(a) Timber cover, and current land use. Describe production and performance and relate it to his current practices. For a new farmer describe his potential crop rotation and practices.

(b) Fences - boundary and sub-division Examine features and limitations to mechanization etc.

(c) Water supplies - domestic, stock, irrigation

(d) Building, stores and yards - age, condition and capacity

(e) Houses - age, size and condition

***3. Labour***

(a) Availability - family, permanent, casual and contract

(b) Seasonality in labour supply and demand - bottlenecks and slack times

(c) Skill or limitations of present labour

(d) Wage rates (including perquisites)

Calculate the person-days required for each enterprise

- Calculate the monthly requirements in person-days for each enterprise.
- Construct a labour profile for all farm enterprises together.
- Assess the person-days available to the farmer from the family labour supply.
- Examine the labour supply and demand profiles and formulate a strategy for dealing with labour shortfalls and surpluses. Use the following matrix to analyse labour supply and demand.

| Table 3 | **Labour Requirement Per Hectare** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crop : Yaqona | | | | | | | | | | | | | |
| Variety : Loa Kasa Leka, Loa Kasa Balavu, Vula Kasa Balavu, Dokobana Leka, Qila Leka, Matakaro Balavu, Honolulu, Damu, Vula Kasa Leka | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | **Year 1** | | | | | | | | | | | | |
| **Activity** | **Feb** | **March** | **April** | **May** | **June** | **July** | **Aug** | **Sept** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** |
| | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** | **P** |
| Land Clearing | 25 | 25 | | | | | | | | | | | |
| Digging | | | 30 | | | | | | | | | | |
| Planting | | | 30 | | | | | | | | | | |
| Spraying/Weed Control | | | | | | | 25 | | | | | | 24 |
| Fertilizer Application | | | 22 | | | | 22 | | | | | | |
| Harvesting | | | | | | | | | | | | | |
| Cartadge | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Washing | | | | | | | | | | | | | |
| Sundrying | | | | | | | | | | | | | |
| Grading/Sorting | | | | | | | | | | | | | |
| Bailing | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| P - Personday | | | | | | | | | | | | | |

***4. Machinery***

(a) Schedule of machinery owned - including age, condition, values and capacities (if potentially limiting)

(b) Availability of contract services

***5. Capital and credit***

(a) Loans outstanding – amount, term, interest rate, principal payments

(b) Potential sources of capital or credit

***6. Quotas, contracts, etc.***

***7. Farmer's personal constraints or limitations***

**III. Present Farm Organization and Methods**

a. Cash crops – areas, varieties, production methods, inputs used, yield, market prices etc. - summarized in activity budgets

b. Pastures and fodder crops – areas, types, establishment, management, inputs used, yields or carrying capacity etc.–summarized in activity budgets.

c. Livestock - numbers, types and breeds, production methods, inputs used, feeding, disease control, output, prices etc.- summarized in activity budgets.

**IV. Current Performance and Capital Position**

a. Benchmark whole-farm budget of present farm plan.

b. Total assets and liabilities of present position.

3. Measures of farm profitability, equity position, etc.

**V. MARKETING**

1. Define what market access exist in the local and export market, market segment that is targeted, market size, and requirements of the market, marketing infrastructures in place or needed. What are the constraints limiting the farmer from accessing the market.

**2.0 MANAGEMENT REPORT**

**VI. Deficiencies, Opportunities and Suggestions for Change**

2.1. Scope for improvement in methods of production.

2.2. Opportunities for new enterprises/activities.

2.3. Possible farm reorganization - changes in the levels of enterprises.

2.4. Scope for increasing resource base or breaking existing constraints.

**2.5 Suggestions for Improvement:**

*2.5.1) You must "Identify solutions and options"*

**2.5.2 Analyze solutions and options through the gross margin analysis, enterprise budgets, consolidated cash flow budget, partial budgeting.**

**2.5.3) The farmer then selects the best option that is available for him.**

***The selected option becomes the basis of your better farm business plan.***

**(Your options should answer the who, what, when, why and how questions that come with it.)**

**Use the following matrix to analyse your constraints and solutions by enterprises.**

## 4.0 MANAGEMENT REPORT OF NAVUSO FARM- CONSTRAINTS & SOLUTIONS

| Enterprises | Factors of production | Major constraints | Minor constraints | Goals/ Objective | Changes of current practices | Recommendations & Solutions |
|---|---|---|---|---|---|---|
| **Dairy** | Land and Genetics | Drainage problems<br>Weed infestation of navua sedge & yellow primrose<br><br>Poor genetic improvement<br><br>Low number of milking cows hence showing poor utilization of land. | Thefts | Optimize returns from the Dairy through pasture improvement and restocking with improved genetics. | - Uncontrolled Grazing and mating | -Increase milking cows to 500 over the next 7 years.<br>-Procurement of genetically improved stock.<br>-Ensure Rotational Grazing of pastures and controlled mating<br>- Improve drainage works<br>- Follow a dalo cropping programme on weed infested blocks before planting of setaria and signal grass.<br><br>Maintain the running of the farm and school as one entity |
| | **Labour and Management** | - unskilled labour<br>- No proper records kept<br>Spliting of school from the farm | Attitude of workers. | Build Capacity of workers and improve hygiene factors of working conditions | Volunteer Labourer | Employ a qualified Livestock Manager.<br>Employ High skilled labour<br>Training on stockmanship and Dairy management with labourers.<br>Maintain the school and farm as an entity under the same management board.<br>Good organization of student laborers on the farm. |

## 3.0 BETTER FARM BUSINESS PLAN OR PROPOSED FARM BUSINESS PLAN

3.1 The best strategy or option in terms of cropping or livestock mix becomes the basis of the Better Farm Plan or Proposed Farm Plan showing clearly what the farmer is going to do, how much he is going to do and when they will be done.

3.2 Procedure for developing a farm plan

Step 1. Formulate goals and objectives

Step 2. Prepare farm resources inventory

Step 3. Identify opportunities and prepare an action plan

Step 4. Prepare enterprise budgets and select the most profitable

Step 5. Prepare a whole farm budget and action plan

Step 6. Put the plan into action if you a farmer.

Step 7: Keep good records of activities and financial income and expenditures

Step 7: Learn from the mistakes through your records and respond timely to the changes.

3.3 Detailed physical and financial plans will be required and done in all the phases and steps shown below. This will include the production plan, marketing plan, management plan and Financial Plan. Use the following table to draw your physical Plan.

| NAVUSO FARM 4 YEAR CROP EXPANSION PROGRAMME | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crop | | Year 1 | | | Year 2 | | | Year 3 | | | Year 4 | | |
| | Unit | Area Planted | Estimated Yield(kg) | Estimated Value[$] | Area Planted (ha) | Estimated Yield(kg) | Estimated Value[$] | Area Planted | Estimated Yield(kg) | Estimated Value[$] | Area Planted | Estimated Yield | Estimated Value[$] |
| Ginger | ha | 0.5 | 5000 | 3,500 | 0.4 | 10000 | 7,000 | 0.4 | 10000 | 7,000 | 0.4 | 10000 | 7,000 |
| Dalo[Tausala] | HA | 6 | 60000 | 78,000 | 24 | 240000 | 240,000 | 28 | 280000 | 280,000 | 22 | 220000 | 220,000 |
| Dalo[Mix] | HA | 2.5 | 25000 | 25,000 | 3 | 30000 | 30,000 | 4 | 40000 | 40,000 | 5 | 50000 | 50,000 |
| Cassava | ha | 2 | 30000 | 6,000 | 3 | 45000 | 6,000 | 4 | 60000 | 48,000 | 5 | 75000 | 60,000 |
| Water Melon | ha | 1 | 15000 | 27,000 | 2 | 30000 | 54,000 | 3 | 45000 | 81,000 | 4 | 60000 | 108,000 |
| Total | | 12 | | 139,500 | 32.4 | 125 | 337,000 | 39.4 | 891039 | 456,000 | 36.4 | 415000 | 445,000 |
| | | | | | | | | | | | | | |
| Variable Costs of Production | | | | | | | | | | | | | |
| Ginger | | | | 3787.5 | | | 3,030 | | | 3,030 | | | 3,030 |
| Dalo Tausala | | | | 36570 | | | 152,280 | | | 177,660 | | | 139,530 |
| Dalo Mix | | | | 9615 | | | 11,538 | | | 15,384 | | | 19,230 |
| Cassava | | | | 10544 | | | 15,816 | | | 20,608 | | | 26,360 |
| Watermelon | | | | 2985 | | | 5,970 | | | 11,940 | | | 11,940 |
| Total Variable Costs | | | | 63501.5 | | | 188634 | | | 228622 | | | 200090 |
| Gross Margin | | | | 75,999 | | | 148,366 | | | 227,378 | | | 244,910 |

**3.3.1 The Production Plan should be showing all the good agricultural practices. The marketing plan will s**pecify what, how, where, by whom, products and services will be marketed. Marketing should include grading, packing, packaging and handling, distribution chain to market transaction point. It will describe the market for the product(s) including price trends, seasonal trends, quality requirements, risks and competition.

3.3.2 The management plan should describe the tasks to be managed, and shows that each essential task will be managed by a stated person who has the experience and competence to do that task. It will also show how the business is organized and its processes, positions and responsibilities. All tasks including production, marketing and financial management - and record keeping – are covered.

**3.3.3 The financial plan will show the** forecast of income and expenditure budgets (modified from Financial Statements in the Property Report), and sources of capital needs. If a loan is planned, the Plan will show how repayments will be covered. It will include a risk sensitivity analysis. It may also include a assessment of the debt to equity ratio. The Plan may describe a strategy for skills improvement or assistance to prepare loan a application.

**3.5 Detailed steps in Preparing a better farm business plan or proposed farm business plan.**

3.5.1 Step 1

**Assess resources available**

The plan should first be expressed in physical terms. An assessment will be needed of the resources available to the farmer and the area of each crop and number of each type of livestock available. This also involves identifying the potential crops that can be grown from the farmer's resource base and within the limits of what the market wants.

3.5.2 Step 2

**Prepare budgets for the different farm enterprises**

The enterprise budgets or gross margins are brought to as per unit basis for comparisons to be made. The range of farm enterprises should include new enterprises identified through the market plan. The farmer should also take into account the decision as to whether to

specialize in a few enterprises, or alternatively, to diversify production and spread risks. Supplementary enterprises, such as small-scale livestock, can also be included especially if they are held around the homestead and do not compete for scarce resources. These enterprises will add to the overall farm profit or income. Use the following table to draw up enterprise budgets and analysis.

| ENTERPRISE ANALYSIS | | | | | |
|---|---|---|---|---|---|
| | ***Farming System - Cultivated under Traditional Farming System*** | | | | Plant Density : 2500 mounds |
| | ***Assumptions*** | | | | |
| 1 | Spacing | 3m x 3m | |  | |
| 2 | Production & Income Schedule | | | | Total |
| | Number of plants | ha | 1 | | 10000 |
| | Yield per plant Waka | kg | | | 0 |
| | Lewena - per plant | kg | | | 0 |
| | Production - Waka Dried | kg | 0 | | 0 |
| | - Lewena Dried | kg | 0 | | 0 |
| | Home Consumption Waka | | | | |
| | Marketable Production (90%) - Waka | kg | 1890 | | 1890 |
| | - Lewena | kg | 0 | | 0 |
| | Price/kg (Waka) | $ | 20 | | 20 |
| | Price/kg (Lewena) | $ | 12 | | 12 |
| | Value of Waka | | | | |
| | Value of Lewena | | | | |
| | **Gross Value of Output** | **$** | **37800** | | **37,800** |
| | | | | | |
| | | Unit | Quantity | Unit Cost | Total Costs |
| 3 | **Direct Costs** | | | | |
| | **Inputs** | | | | |
| | NPK | kg | 75 | 3.5 | **79** |
| | Urea | kg | 75 | 3.0 | **225** |
| | Glyphosate CT | litre | 4 | 9.6 | **38** |
| | Paraquat | litre | 12 | 13.0 | **156** |
| | | | | | |
| | Planting Material | cuttings | 7500 | 0.30 | **2250** |
| | | | | | |
| | **Total Input Costs** | | | | **2748** |
| | | | | | |
| 4 | **Labour inputs** | | | | |
| | Land Clearing | personday | 50 | 20 | **1000** |
| | Digging | personday | 30 | 20 | **600** |
| | Planting | personday | 30 | 20 | **600** |
| | Spraying/Weed Control | personday | 177 | 20 | **3540** |
| | Fertilizer Application | personday | 44 | 20 | **880** |
| | Harvesting | personday | 60 | 20 | **1200** |
| | Cartadge | personday | 30 | 20 | **600** |
| | Washing | personday | 25 | 20 | **500** |
| | Sundrying | personday | 30 | 20 | **600** |
| | Grading/Sorting | personday | 10 | 20 | **200** |
| | Bailing | personday | 4 | 20 | **80** |
| | **Total Labour Days @$20/personday** | | **490** | | **9,800** |
| | | | | | |
| 5 | Transport | trip | 1 | 500 | **500** |
| 6 | **Total Variable Costs** | **$** | | | **13,048** |
| 7 | **Gross Margin/ha including Labour** | **$** | | | **$24,752** |
| 8 | **Gross Margin/ha excluding Labour** | **$** | | | **$34,552** |
| 9 | **Return/Labour Inputs** | **$** | | | **$50.51** |
| 10 | **Breakeven Price/kg (Waka)** | **$** | | | **#DIV/0!** |
| 11 | **Breakeven Yield (Waka)** | **kg** | | | **652** |

3.5.3 Step 3

**Use the enterprise budgets to determine which of the alternative crops and livestock enterprises would yield the highest gross margin. Livestock Budgets should be justified by a good stock build up and feed reconciliation matrix to show pasture supply from the pasture matrix and feed demand based on your stock build up.** This is done while considering the constraints of the limited supplies of labour and sometimes capital. While farmers have a number of resources under their management control, there may be one or two resources that are really in short supply and prevent the farmer from expanding income on the farm. These are called the "most limiting resource", on production. Ways are used to identify which resource it is. Once the limiting resource is found, the problem facing the farmer is to know

how much of an enterprise to produce and with what resources in order to increase profits. Farm enterprises would then be selected in order from that generating the highest gross margin per unit of limiting resource to the lowest. A selected enterprise would be expanded until the limiting resource is all used up. A problem often encountered is to find which resource it is that is the most limiting. The farmers' judgment is needed to assess this. Farmers are the most likely persons to know. Most often land is treated as the limiting resource and planning is conducted on the basis of gross margin per hectare but this may not always be suitable, especially among small farms in Fiji where family labour is often in scarce supply. The limiting resource often depends on local circumstances.

3.5.4 Step 4

**Estimate the total net income for the farm**

The farm plan is initially constructed on the basis of gross margin data expressed as a unit of land or head of livestock. In order to estimate the net farm income, the total gross margin generated from the farm plan must take into account the fixed costs. This shows the profitability of the farm as a whole. In economic terms it is defined as the reward for all the resources contributed by the farm family during the year. Whole farm income is necessary to cover the family living expenses. **Note:** The whole farm income is not the same as the cash the farm family earns. To know precisely the amount of cash available, the costs related to family labour, depreciation and interest must be deducted from the farm income. Use the following table to draw a whole farm budget.

| | 8.0 CONSOLIDATED WHOLE FARM CASHFLOW BUDGET FOR THE PROPOSED NAVUSO BETTER FARM PLAN | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PRODUCTION SCHEDULE AND INCOME | YEAR 1 | YEAR 2 | YEAR 3 | YEAR 4 | YEAR 5 | YEAR 6 | YEAR 7 |
| | Opening Bank Statement | | 431282 | 188,050 | 218,389 | 484,339 | 801,139 | 1,129,189 |
| | Fiji Development Bank Loan | 750000 | | | | | | |
| 1 | DALO -Tausala | 78000 | 240000 | 280000 | 220000 | 220000 | 220000 | 220000 |
| 2 | Dalo Mix | 25000 | 30000 | 40000 | 50000 | 50000 | 50000 | 50000 |
| 3 | Cassava | 6000 | 6000 | 48000 | 60000 | 60000 | 60000 | 60000 |
| 4 | Watermelon | 27000 | 54000 | 81000 | 108000 | 108000 | 108000 | 108000 |
| 5 | Dairy | 57487 | 86850 | 117560 | 180300 | 239250 | 259500 | 405000 |
| 6 | Chicken - Broiler | | 164000 | 164000 | 164000 | 164000 | 164000 | 164000 |
| 7 | Chicken -layer | | | | | | | |
| 8 | Piggery | | | | 240000 | 240000 | 240000 | 240000 |
| 9 | Coconuts | | | | | | | |
| | TOTAL INCOME &LOAN | $943,487 | $1,012,132 | $918,610 | $1,240,689 | $1,565,589 | $1,902,639 | $2,376,189 |
| | EXPENDITURES | | | | | | | |
| | VARIABLE COSTS | | | | | | | |
| | Dalo - Tausala | 30,912 | 98,450 | 127,675 | 131,900 | 139,500 | 139,500 | 139,590 |
| | Dalo-Mix | 12,880 | 15,456 | 20,608 | 25,760 | 25,760 | 25,760 | 25,760 |
| | Cassava | 10,544 | 15,816 | 20,608 | 26,360 | 26,360 | 26,360 | 26,360 |
| | Watermelon | 2,985 | 5,970 | 11,940 | 11,940 | 11,940 | 11,940 | 11,940 |
| | Dairy | 16,800 | 26,000 | 37,000 | 43,000 | 43,500 | 52,500 | 80,000 |
| | Chicken | 47,084 | 94,190 | 94,190 | 94,190 | 94,190 | 94,190 | 94,190 |
| | Piggery | | 25,000 | 25,000 | 120,000 | 120,000 | 120,000 | 120,000 |
| | TOTAL VARIABLE COSTS | 121,205 | 280,882 | 337,021 | 453,150 | 461,250 | 470,250 | 497,840 |
| | GROSS MARGIN | 822,282 | 731,250 | 581,589 | 787,539 | 1,104,339 | 1,432,389 | 1,878,349 |
| | FIXED COSTS | | | | | | | |
| | General Manager | 40000 | 40000 | 40000 | 40000 | 40000 | 40000 | 40000 |
| | Crop Manager | 15000 | 15000 | 15000 | 15000 | 15000 | 15000 | 15000 |
| | Livestock Manager | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 |
| | Farm Hands | 60000 | 60000 | 60000 | 60000 | 60000 | 60000 | 60000 |
| | Clerical Officer | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 |
| | FNPF | 7000 | 7000 | 7000 | 7000 | 7000 | 7000 | 7000 |
| | Tractor Repairs & Maintenance | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| | Fuel | 12000 | 12000 | 12000 | 12000 | 12000 | 12000 | 12000 |
| | FDB Loan Repayment | | 93200 | 93200 | 93200 | 93200 | 93200 | 93200 |
| | Contingencies | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 |
| | SUB TOTAL FIXED COSTS | 163000 | 256200 | 256200 | 256200 | 256200 | 256200 | 256200 |
| | TOTAL OPERATIONAL COSTS | 284,205 | 537,082 | 593,221 | 709,350 | 717,450 | 726,450 | 754,040 |
| | OPERATING PROFIT | 659,282 | 475,050 | 325,389 | 531,339 | 848,139 | 1,176,189 | 1,622,149 |
| | CAPITAL COSTS | | | | | | | |
| | Tractor | 105,000 | 75,000 | | | | | |
| | 4Wheel Drive | | 45,000 | | | | | |
| | Carrier | | | 60,000 | | | | |
| | Packing and Farm Shed | | 50,000 | | | | | |
| | POULTRY Shed | 25,000 | | | | | | |
| | Purchase of Pig stock | | 20,000 | | | | | |
| | Layer Shed | | 50,000 | | | | | |
| | Coconut Development | | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| | Purchase of Dairy cows | 28,000 | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 | 12,000 |
| | Fencing Development | 60,000 | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| | Pasture Improvement | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| | SUB TOTAL CAPITAL COSTS | 228,000 | 287,000 | 107,000 | 47,000 | 47,000 | 47,000 | 47,000 |
| | TOTAL OPERATIONAL &CAPITAL COST | 512,205 | 824,082 | 700,221 | 756,350 | 764,450 | 773,450 | 801,040 |
| | SURPLUS/DEFICIT | 431,282 | 188,050 | 218,389 | 484,339 | 801,139 | 1,129,189 | 1,575,149 |
| | Closing Bank Statement | 431282 | 188,050 | 218,389 | 484,339 | 801,139 | 1,129,189 | 1,575,149 |
| | FINANCING PLAN- FDB Loan -$750,000 in year 1. | | | | | | | |

**PLEASE CHECK YOUR WORK AND ENSURE THAT YOUR ASSUMPTIONS ARE BASED ON VERIFIABLE INFORMATION.**

# APPENDIX 2C
# AGRICULTURE PROPERTY VALUATION

## INTRODUCTION

**LAND**: Is most commonly regarded as being merely a solid part of the earth surface, ground or soil

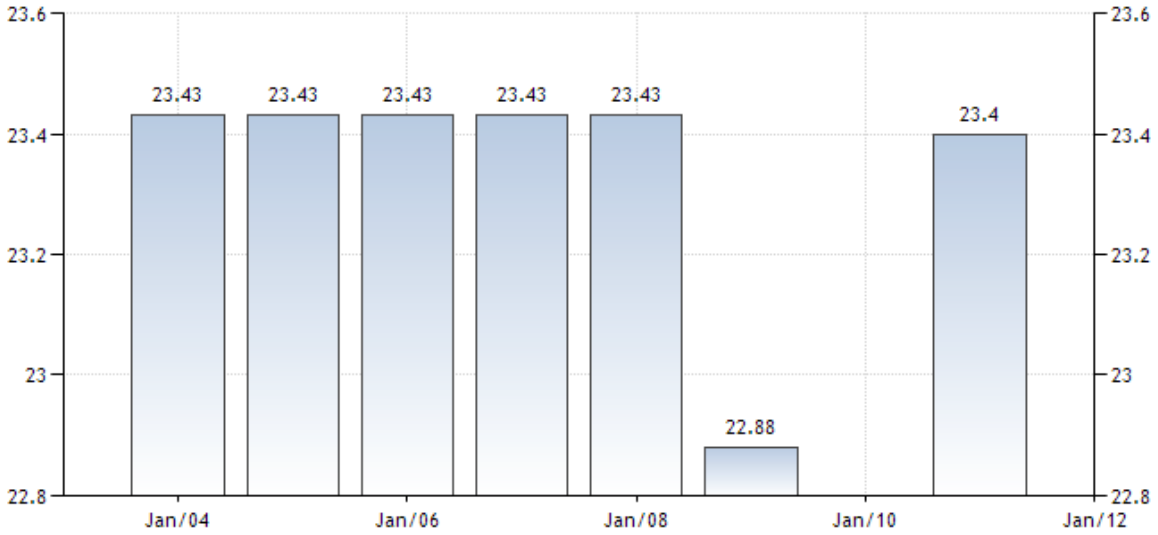
**In a Legal sense and also as the subject of Valuation:**
Land means any ground, soil, earth or air-space whatsoever, whether above or below the water level and it includes all building and improvements on the land and everything else attached to or appertaining to the land whether above or below the surface. Under common law the fee simple of land is what we commonly referred to as REAL PROPERTY or as most are more familiar with is "REAL ESTATE" In general this classification represents broadly the difference between immovable property [Land] and movable property [Chattels].

The Torrens System of land tenure has been adopted by most commonwealth states and numerous developed and developing countries. Fiji is no exception and has integrated this with its own form of customary or native land tenure system. This allows the proper record and administration of land titles and the recognition of Estate in Fee Simple as against Leasehold the enjoyment and benefit of absolute ownership. It is the greatest right that can be held in land. It is an estate of freehold and is inheritable; It carries the highest form of rights of land ownership, of use and of alienation ie for the purpose of sale etc. Leasehold is of a lesser intensity.

**MARKET VALUE OF LAND:** Like that of most commodities is governed by the law of supply and demand. The definition and concept of value is derived from the authoritatively formulated and widely accepted landmark ruling in *Spencer vs The Commonwealth of Australia.*

*Basically it is "A PRICE which a property will derive after being agreed to by a WILLING SELLER AND A WILLING BUYER unaffected or coerced by external or abnormal influences"*
[Ref : Rost & Collins, Land Valuation and Compensation, 3RD Edition 1984]

**Composition of Agricultural land in Fiji measured in percentage**
Agricultural land in Fiji was last measured in 2011 and stands at 23.40 %. According to the World Bank, Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest,. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops.




Information : Food and Agriculture Organization 2011

WHAT LAND QUALIFIES?

The land must meet the following:

The land must be devoted principally to agricultural use. Agricultural use includes production of crops, livestock, poultry, fish or cover crops. It also can include leaving the land idle or for normal crop or livestock rotation. Land used for raising certain exotic animals (including exotic birds) to produce human food or other items of commercial value and cutting wood for use in fences or structures on adjacent agricultural land also qualifies. Agricultural land must be devoted to production at a level of intensity that is common in the local area. The land must have been devoted to agricultural production and zoned as such and is not inside the limits of a city or town.

WHAT IS REQUIRED FOR AGRICULTURE VALUATION

1. The land is or properly classified or zoned agricultural in accordance with the Town and Country planning regulations and provisions.
2. The land under leasing conditions is being issued for the purpose of agriculture development.
3. The land is solely for agricultural purpose as defined under the land use classification provisions.
4. The land is principally for agriculture use under the Agricultural Landlord and Tenant Act [ALTA].
5. Agriculture holding means a parcel of agriculture to which the provision of the ALTA Act applies.
6. Agriculture Land: means together with any buildings thereon, used, or proposed to be used predominantly for the growing of crops, dairy farming, forestry, horticulture, bee keeping, poultry or the breeding, rearing or keeping of livestock.
7. Contract of Tenancy: means any contract expresses or implied or presumed to exist under the provisions of the ALTA act that creates a tenancy in respect of agricultural land or any transaction that creates a right to cultivate or use any agricultural land.
8. A contract of tenancy shall be evidenced by an instrument in writing called an instrument of tenancy.
9. The instrument of tenancy or lease shall contain the term of lease, rent, name of parties, signatories to the contract, area, locality plan and other terms, covenants and conditions of the lease which defines the contract.
10. The agricultural valuation/appraisal estimate [VALUE OF THE PROPERTY] is arrived at on the basis of the above information and the analysis of the property market sales within the

vicinity of the subject area being assessed.

## MOA INFORMATION FOR EXTENSION OFFICERS

**BASIC PROPERTY VALUATION ASSESSMENT**
**SALES OF PROPERTY**

Valuation must be based on relevant sales evidence. It is most important for the valuer to obtain a detailed knowledge of all relevant sales within the area where the valuation is to be determined. Inspection and analysis of these sales will enable each one to be compared in detail with the others and the property to be valued so that the basis for determining a value can be established.

In the application of data derived from investigation and analysis of market transaction to the valuation of a subject property. The usual objective of the valuer is to ascertain as best he can the capital sum which the subject property is expected to realize at the date and point in time of its assessment in the field.

Methods differ according to circumstances and will depend on the type of property being valued. For agricultural purposes the following are common methods of applications in its basic form.

**SCENARIO 1 Case Study:** SUMMATION or COST METHOD OF ASSESSMENT
[*It is commonly used in valuing house property; etc to arrive at its total value without the use of direct comparison method. It will not be applicable if the improvements do not contribute to the best permissible use of the site.*]

**Improvements on the Land**
Fixed Assets Only
Building and Structural Improvements.
To Determine the present value of EXISTING IMPROVEMENTS
Take the Area measurement of the existing Improvements/Structures
Eg- Farm House
Piggery Shed
Poultry Shed
Milking Shed
Etc

- Assume if the above is to be newly constructed
- Obtain quotation/costs of building materials

Note the type of existing improvements ie. Timber, Roofing iron, Concrete etc

**Less Depreciation**
Formula for Depreciation i.e. Age of the Structure x 100%
Expected Lifespan

Eg 10/ 50 = 0.20 x 100% = 20%

Ie. Cost of new Improvements – Depreciation = Present Value
Gives the Present Value for the Improvements Only

**Livestock, Root crops etc**
Take an inventory of the total live stock and crops on the farm and quantify this with

current market prices available in the market at the point of time of the assessment.

**C) Land Value**

Total Area of the property X Rate per Area( Hec or Acre)
(Rates obtained vide property sales analysis)

Improvements available to the Land
Eg Public Services and infrastructure eg Roads, Electricity, Pipe Water etc
Measured at 5% to 15% [+ or minus]
D) Therefore; MARKET VALUE;
Total Value of Buildings/ fixed Structures +Livestock + Land Value + Improvements available to the Land = MARKET VALUE of the Farm Property

**SENARIO 2 Case Study: PRODUCTIVITY METHOD OF VALUATION**

*The productivity method of valuation is associated mainly with rural land. It involves the capitalization of hypothetical net returns and assumes average efficiency of property management.* [Information *is to be sourced from sighted and reliable records and interview with the farmer*] Figures adopted are assumptions for practical purpose only.

**ANNUAL INCOME**

Live stock Sales etc…

| | |
|---|---|
| Live cattle 10 @ $800.00 per cattle | = $8,000. |
| Pigs 20 @ $350.00 per pig | = $7,000. |
| Chicken 100 @ $15.00 each | = $1,500. |
| Vegetable Sales | |
| Bele, rourou, cabbage, etc | = $800. |

**Crop Sales**

| | | |
|---|---|---|
| *Dalo* | *- Acrage, bundle, 50kg bag etc* | = $3,000. |
| Yams | - 10 mounts,$$/average weight etc | = $ 800. |
| Cassava | - 110 mounts/basket etc | = $1,500. |
| Total Income | :$22,600.00 | |

Capital Assets:
i) Fixed Assets:
Dwelling/Residence or Farm House…... $25,000.
Cow shed ……..… $5,000.
Piggery Shed …… $4,500.
Chicken shed …….. $5,500.
**Total Fixed Assets : $ 40,000**

ii) Stock at hand:
Cattle 15 …… $8,000.
Pigs 20 …….. $ 5,000.
Chickens 200 …… $1,600.
Total Stock: $14,600

**EXPENDITURE**

| | |
|---|---|
| Wages | - |
| - Management $90.00 pw | - |
| - Casual $70.00 pw x 2 | - |
| Animal Health | - |
| Fertilizer | - |

Weed control -
Cartage -
Vehicles and Transportation -
Repairs and Maintenance
- Buildings 2.5% of $25,000.00 -
- Fencing 5%of $2,000.00 -
- Sheds 5% of $15,000.00 -
viii) Depreciation
- Fixed Assets [Building 2% Sheds 4%]
Assuming Total Expenses:$15,500.00
C. Capitalization of Net Income
Surplus ( $22,600 - $15,500 )…… $7,100.00
Capitalized @ ( X%).....$142,000.00
Productive Value = $142,000.00

Note:
*Law Courts and practicing valuers when invited to consider the PRODUCTIVITY METHOD have frequently rejected it as a conclusive and reliable primary basis of valuation.*

i) Reading vs The Valuer General (1923) ii) Australian Estates and Mortgage Co LTD vs Commissioner of Land Tax (1933)……..

**Factors associated with this**
Low productivity due to poor management and expenditure control
Poor record keeping leading to unreliable information
Maximum utilization and best use concepts not adopted
As a result the property can either be underestimated or not assessed to its true potential value.

**However** Estimates of Net Returns, is suitable as a primary basis of valuation for SHORT **TERM Budgeting.** This is often useful by Banks and other lending institutions to determine the risk element and the ability of an applicant to service a LOAN and the estimate of the net returns to an investment in a given period of time.

**DIRECT COMPARISON or MARKET DATA METHOD of VALUATION**
This method is used in cases where sale and subject lands, improved or vacant area significantly alike to enable them to be compared without much adjustment for points of difference. The method is used mainly for unimproved vacant land and not for improved land

**HYPOTHETICAL DEVELOPMENT METHOD of VALUATION**
The method is used to determine the value of the land which has not been developed or used to its highest potential and best use.

The later 2 methods are normally used by persons having possessed with advanced skill and knowledge of the discipline.

**AGRICULTURAL VALUATION UNDERTAKEN BY THE MINISTRY**

[Sample - For information & training purpose only. This is not the original version of the report as Parts of it have been edited and names of alias companies used for the purpose of the FM Manual]

**Ministry of Agriculture**
Land Resource Planning and Development Division

PO Box 5442, Raiwaqa
Phone: (+679) 347 7044 Ref No.: LRPD/VC
Fax: (+679) 340 0262

## VANUA ESTATE COMPANY LIMITED
## PROPERTY REPORT AND VALUATION

## PROPERTY REPORT AND VALUATION

Purpose of Valuation: In accordance with the instructions received from the Deputy Permanent Secretary/Agriculture Development of the Ministry of Agriculture, the report shall be presented to ascertain the market value of the following property entities namely CT 25242,CT25037,X1/05,214,CT11508,CT37/3686,CT32/3207&CT17/1613 listed under Vanua Estate Company Limited as proprietors and X Farms Fiji as unregistered leaseholder in their existing and current form as at the date of inspection.

Date of Valuation : 10th May 2013 also being the date of the inspection being done

Property Legalities:

| Title | Number | Description | District/Tikina | Area Hectares | Undivided Share |
|---|---|---|---|---|---|
| CT | 25242 | Lots1&3 DP6124,Tamanoa | Navua | 153.1233 [378.37Acres] | Whole |
| CT | 25037 | Lots 1&2 DP6123Tamanoa(part of) | Navua | 102.8937 [254.25Acres] | Whole |
| CT | 17/1613 | Calia (part of) DP 128 | Navua | 202.3472 [500 Acres] | Whole |
| CT | 32/3207 | Calia(part of) NS49 | Navua | 323.7556 [800 Acres] | Whole |
| CT | 11058 | Wainikavika DP2731 | Navua | 231.0805 [571 Acres] | Whole |
| CT | X1/05,214 | Tana | Serua | 72.4403 [179 Acres] | Whole |
| CT | 37/3686 | Raiwaqa (part of) | Navua | 32.7803 [81 Acres] | Whole |

Details of the listed properties are given in the attached copies of the certificate of titles

At the time of a registry search being undertaken dated 13th May 2013 there remains an uncancelled registered lease held by Macphona Trustees Ltd / Highway Stabilizers International Trust Co. for 30 years commencing 1ST April 2005

## VANUA ESTATE COMPANY LIMITED

Property Title No CT25242
The subject property transcends both sides of the main Queens Road beginning from the Navua banks on the Deuba end of the Navua Bridge. Improvements include the prawn shop building, administration block, refrigeration storage shed, and barb wire fencings. The workshop/ garage and piggery sheds are in extreme poor condition.

Property Title No CT 25037
Open Pasture demarcated with enclosed barbwire fencing with shared common boundaries with property title No CT 25242.Improvements include the double story quarters in severe state of depreciation .and milking sheds.

Property Title No CT 17/1613 on DP128
The property is sandwiched between Wainikavika and Calia (part of) NS 49 and is located at the town end of Navua River. Situated in this property is the fish and prawn farm which includes the hatchery, farm house, rearing shed and 31rearing ponds alongside Waiyanituroad. The northern portions along the dam is covered with hilly terrain and forest.

Property Title No 32/3207 on NS 49
The cadastral layout is irregular in shape forming long rectangular strips with its northern end boundaries covered with lush hilly / forestry vegetation. The property is positioned alongside property No CT17/1613 on DP128.

Property Title No 11058 on DP 2731
Much of the entire property which was previously under rice cultivation predominantly covered with pasture. Due to neglect pasture grass is now infested with weeds Mostly alluvial flatlands with potential for good arable class 2 land use classification, provided proper drainage rehabilitation and systems is in place. The water catchment dam runs along the property and Calia part of DP 128.

Property Title No X1/05,214
Prominently under forest cover and is located north west of Wainikavika and north east of Raiwaqa land resettlement agricultural subdivision with wainikavika creek running along the north east end boundaries.

## VANUA ESTATE COMPANY LIMITED

Property Title No 37/3686
The land is legally delineated as Raiwaqa part of Land Use Zoning.

The properties along the Queens road highway is predominantly under 2 to 3 classification well suited for the establishment of livestock pasture and for dairy purposes with moderate limitations. Soils are reasonably fertile with high level water retaining capacity for the flat lands, integrated with swampland/pit soils due to its even and low lying terrain. For the properties in Wainikavika and Calia towards the northern and eastern ends; The land classification ranges from class 2 to 4 for the low lying flats and 6 and 7 for the hilly lands and steep ridges under forest cover.

**Land Utilization**
**Improvements " To the Sites"**
Properties at the Deuba end of Navuariverhave good roading access vide the main Queens road highway Similarly with the properties along Waiyanitu road. Within a 5 km radius of Navua township the Vanua Estate Co Ltd properties have access to the main local urban township services/amenities, primary and secondary schools with infrastructure such as roads, electricity power, pipe water reticulation, telephone lines etc conveniently available and easily accessible.

**Improvements "On the sites"**
The properties have been fully surveyed with improvements defined in the individual relevant certificate of titles

**Market Conditions**
The character of the properties are determined by such factors as geographical location, physical terrain, land use capabilities, infrastructure, accessibility to public services, amenities etc .To increase the marketability and profit level of the subject property is to realize its potential value. In addition to its use for dairy/grazing and fish/prawn operations ;The property has the potential for cash crops and exportable root-crops/vegetable, fruits etc cultivation provided the drainage systems are properly rehabilitated and upgraded.

## VANUA ESTATE COMPANY LIMITED

### Agricultural Property Sales

| Vendor | Purchaser | Title Ref<br>Location | Area<br>[Hec/Acre] | Sale Price<br>Sale Date | Rate/Hec<br>($$) | Rate/Acr<br>($$) | Comments |
|---|---|---|---|---|---|---|---|
| Kevin Li Yu | Genshun Jin | CT35856 LOT 1 DP 9175 BLOCK 1 Deuba | 242.55<br>599.34 | $1,001,500.00<br>11-AUG-11 | 4100 | 1600 | 5 |
| Garry Higgins | Kim Poindexter | CT34128 LOT 1 DP 8684 DeubaSerua | 11.86 Ha<br>29 1 8.97 | $100,000.00<br>12-OCT-11 | 8500 | 3400 | 43 |
| P. Namulo & L. Namulo. | Paquana PTE Ltd | CT23784 LOT 5 DP 5346 Serua / Namosi | 3.2763 Ha<br>8 0 15.32 | $462,000.00<br>12-OCT-11 | | | 44 |
| Viniana Robici Mcgoon | Johanna Latumata Dutta | CT35958 LOT 1 DP 9129 DeubaSerua | 10.3495 Ha<br>25 2 11.89 | $13,750.00<br>09-MAY-11 | 1300 | 550 | 45 |
| OmWati, Rajendra Nath & Rohit Nath | Mul Chand Prasad (Sold With Lot 4 DP 3292) | CT13253 LOT 3 DP 3292, LOT 7 DP 5271 Serua | 1.9966 Ha<br>4 3 29.4 | $130,000.00<br>14-OCT-11 | * | * | 51 |
| Nilesh Chand | Melania Yam | CT34114 LOT 2 DP 8739 Serua/ Namosi Deuba | 14.09 Ha<br>34 3 10.62 | $60,000.00<br>31-OCT-11 | 4300 | 1700 | 52 |
| Star Dust Cruises LTD | AzaadMohd | CT17179 LOT 3 DP 3714 Veivatuloa Serua/Namosi | 3.4322 Ha<br>8 1 37 | $87,400.00<br>17-NOV-11 | * | * | 53 |
| Peter Savona | Daniel V. Chandra & Ritanjali Goundar | CT24667 LOT 9 DP 2054 Calia Navua | 2.3472 Ha<br>5 3 8 | $80,000.00<br>28-DEC-11 | 34000 | 13800 | 3 |
| Narendra Chand | Litia. B. Duabau & others | CT33177 LOT 12 DP 6998 formerly part of Lots 10 &11 | .4165 Ha<br>1 .029 | $110,000.00<br>02-MAY-12 | * | * | |
| OM WATI & OTHERS | MUL C PRASAD | CT38458 LOT 1 DP 9085 | 7.2751 Ha<br>17 3 36.34 | $155,000.00<br>07-MAY-12 | 21300 | 8700 | |
| Total Sales | 10 | | | | | | |

### Sales Analysis

Several agricultural properties were identified within the Deuba and Navua areas even though the market has not been volatile for the last 3 years. Most of the sales are confined to residential and commercial business operations. However some agriculture property transactions have been identified but with less intensity resulting in a range of differentials in the rates. After taking into careful consideration the trends in the real estate property market, the state of the subject properties and documentary information available to me. It is my professional opinion that we adopt a rate of $3,500.00/hectare for the prime lots CT 25242 and CT25037 along the Dueba end of the Queens road . For lots CT 17/1613, CT 32/3207 and CT11058 I have adopted a rate of $2,000.00 and for lots CT XI/05,214 and CT 37/3686 a rate of $3,000.00 per hectare.

## VANUA ESTATE COMPANY LIMITED

**MARKET VALUATION**

In consideration of the foregoing information made it is my qualified opinion that the unencumbered Market Values adopted for the fixed assets which include Land and Improvements and the non fixed assets ie the Dairy Live stock and Prawn Farm Operations amounts to $3,501,968.00 ie Three Million, Five Hundred and One Thousand, and Nine Hundred and Sixty Eight Dollars:

Fixed Assets

| | | |
|---|---|---|
| CT 25242 | | |
| Prawn shop | - | $ 80,400.00 |
| Administration office | - | $ 45,500.00 |
| Refrigeration shed | - | $ 25,000.00 |
| Garage/Workshop/storage sheds | - | $ 30,000.00 |
| Piggery Sheds | - | $ 45,000.00 |
| Land Value | - | $ 529,718.00 |
| Market Value: | - | $755, 618,00 |
| | | |
| CT 25037 | | |
| Milking shed and chilling plant | - | $35,000.00 |
| Farm quarters | - | $55,300.00 |
| Land Value | - | $355,950.00 |
| Market Value | - | $446,250.00 |
| | | |
| CT 17/1613 | | |
| Hatchery, | - | $8,000.00 |
| Farm house, | - | $12,000.00 |
| Office/Rearing shed | - | $10,000.00 |
| Land Value | - | $400,000.00 |
| Market Value | | $430,000.00 |

(iv) CT32/3207
Market Value $640,000.00

(v) CT11058
Market Value $456,800.00

(vi) CT XI/05,214
Market Value $214,800.00

(vii) CT 37/3686
Market Value $97,200.00

B. Non Fixed Assets $461,300.00

## VANUA ESTATE COMPANY LIMITED

In ascertaining the basis of this valuation I have taken into consideration several mitigating factors:-
The use of current property values and the going interest rates with the appropriate adjustments made to take into consideration the nature of the individual subject properties and its operations.

There was no precise demarcation of the boundaries being done but there was sufficient information extracted through maps, plans and documents including the actual physical on the site inspection to have a fair idea as to the location of the properties.

Information derived through investigations/search revealed that X Farms Fiji took up a sales and purchase agreement with the government for Vanua Estate Co Ltd for $700,000.00. [vide the Ministry of Public Enterprises]. However no significant or major improvements were done to the pastures, building structures etc except for some barbwire fencing works and extension to the milking sheds and prawn farm.

At the time of this valuation a lease has not been registered with the Registrar of Titles so the report will not be able to quantify with justification the legal interests of X Farms Fiji nor its assets except Vanua Estate Co Ltd as the legally registered entity Seven Acres
(7 acres) has been allocated to All Earthquakes Limited for quarry extraction.

One Acre (1acre) to Heritage Golf Fiji Limited. The report makes no assessment or deem to express an opinion of the operations of (iv) and (v) as it is does not fall within the terms of this valuation. Information on the total Dairy livestock and prawn farm operations deemed to be non fixed assets is assessed @ $461,300.00. Office equipment and machinery is excluded.

At the time of the completion and submission of this valuation, the Bill of Sale stipulating the terms of agreement between X Farms Fiji and the Government with the office of the Ministry of Public Enterprises was not sighted for reasons of confidentiality. However this will have no bearing on the final outcome of the opinions expressed as the market valuation is based on analysis of the capital fixed and current assets of the legal entity registered as Vanua Estate Company Ltd as the proprietor.

The state of structural improvements is determined after allowing for depreciation
I have adopted the Summation or Cost, Market Data analysis; Direct Comparison and the Productivity Analysis Methods of Valuation where it applies as the basis in ascertaining the Market Value .These principle methods are universally adopted and specifically apply to rural agricultural properties. The comparative figures are derived from market transactions which have occurred for the last 3 years and are than amortized to reflect the properties being valued.

As a standard practice the right and use of this report is restricted to the Ministry of Agriculture. The undersigned shall hold no responsibility for its use either in part or the whole of its contents for any other purpose without first obtaining approval and consent vide proper consultation.

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**Mr. Varea. K . Panapasa**
**BA (LM) , MIVEM , Cert of Val (Lincn).**
**Registered Valuer (RV, Fiji)**
[Signed in accordance with the requirements of the Valuers Registration Board and the Valuers Act of Fiji]

APPENDIX 3

# SYSTEMS AND PROCESSES TO DRIVE THE AGRICULTURE DEVELOPMENT IN FIJI

**BRIEFING PAPER ON SYSTEMS AND PROCESSES TO DRIVE AGRICULTURAL DEVELOPMENT IN FIJI.**

**Purpose –** The purpose of this report is to show all the systems and processes that will need to be followed closely in order to ensure the efficient and effective development of the agricultural sector in Fiji.

**SYSTEMS AND PROCESSES IN AGRICULTURE.**

A **system** is a set of interacting or interdependent components forming an integrated whole or a set of elements (often called *'components'* ) and relationships which are different from relationships of the set or its elements to other elements or sets.

The term *system* may also refer to a set of rules that governs structure and/or behavior. A system has structure, it contains parts (or component's) that are directly or indirectly related to each other. A system has behavior, it contains processes that transform inputs into outputs (material, energy or data). A system has interconnectivity: the parts and processes are connected by structural and/or behavioral relationships.

Systems used in planning, implementation, monitoring and evaluation of policies, programmes and projects related to agricultural development have been developed and used extensively globally. The development of the value chain of demand driven commodities is the target beginning from the farming systems level of production, value addition and to the marketing of agricultural products. When evaluation of farming systems, development projects or value chain development are completed information derived is then used by implementation agencies to re-plan for better policies and plans in the upcoming budgetary year.

When Systems are used correctly and processes are followed and managed properly, the results are improved efficiency in terms of reducing unnecessary costs and improving productivity of the organization.

**IMPORTANT SYSTEMS TO UNDERSTAND IN AGRICULTURAL DEVELOPMENT INCLUDE THE FOLLOWING:**

**LAND USE PLANNING (LAND USE CAPABILITY MAPS)**

Land Use Planning ( LUP) is the systematic assessment of the bio-physical, social, and economic factors - for the purpose of selecting and adopting land use options that are most beneficial to land users. Land Use Plan will indicate the type of limitation that the land have which include Slope or steepness, Present erosion, Potential erosion or erodibility, Wetness or drainage, Fertility (natural), Depth or shallowness, Stoniness (gravelly, bouldery, bare rock),Moisture Holding Capacity or liability to drought, Salinity, Toxicity and Peat. These limitations will dictate the type of interventions in order to improve those limitations. Hence the land use plan of each farm, district, province, divisions and national land use are the main outputs of LRPD.

The LRPD provides this service and every farms and projects should seek their assistance in preparing farm plans or development plans of Districts and Provinces in conducting

Participatory Land Use Planning and Participatory Rural Appraisals. This is to ensure that local knowledge and all sustainable land use practices and conservation measures are incorporated in all planning documents.

The capacity of the Land Use Planning Section in LRPD is weak due to the retirement of experienced staffs and with the retiring of two of its senior staffs this year and this section will be crippled. Hence this will disrupt the planning process in the Department of Agriculture.

**FARM PLANNING AND FARMING SYSTEMS DEVELOPMENT**

Farm Planning and Farming Systems Development Approach is a systematic tool of appraising household systems and communities. This process critically looks at the resource inventory of farmers in terms of the land, labor and capital in relation to the market and the socio economic environment to determine limitations and potential. Constraints of the farming systems and solutions will be identified, alternative options are analyzed and the best option will be the basis of the better farm plan or proposed farm plan.

The use of the Gross Margins, Enterprise Budgeting and Whole Farm Planning/Budgeting tools to profile farmers and determine the profitability of farming systems is important. Every farmer should be provided a Farm Plan based on the potential of his land. Farmers could take these farm plans to the Bank for funding and should be guiding the farmer's daily activities on what to do, how much and when to do.

**FARMER REGISTRATION AND CLASSIFICATION**

Farmers Registration and Classification System should help us to know the number of farmers, what they plant, and area and production records of crops and livestock plus estimates of forecast. Every Locality Officer should have a list of farmers, and he should know his status of food security, and what he can sell to the market. In addition to that his data base should help determine who are the food insecure, where are they, and why? These are the questions every extension officers should be answering and reporting in their quarterly reports.

**COMMODITY INDUSTRY PLAN/VALUE CHAIN DEVELOPMENT**

Based on farming systems analysis and benchmarking surveys and consultation with relevant stakeholders Industry Plans of agricultural commodities are formulated clearly showing the road map on the value chain development of various commodities.

The value chain describes the full range of activities which are required to bring a product or service from conception, through the intermediate phase of production (involving a combination of physical transformation and the input of various producer services), to delivery to final consumers, and final disposal after use.

Value chains are organized linkages among groups of producers, traders, processors, and service providers who join together in order to improve productivity and value added. By joining together, the actors in a value chain increase competitiveness and are better able to maintain competitiveness through innovation. The limitations of each single actor in the chain are overcome by establishing synergies and governance rules aimed at producing higher value.

These are the planning documents that should drive the formulation of PSIP proposals to the Ministry of Finance. These should be the basis of Capital Projects which should be targeted to address specific parts of the value chain as stipulated in the Industry Plan.

## STRATEGIC DEVELOPMENT PLAN, CORPORATE AND BUSINESS PLANS

The annual baseline budgeting systems and process is clear where each department will submit budget estimates that is based on the minimum requirement for each department to carry out their advisory services and provide goods that they are required to provide and are stipulated in the Strategic Development Plans, Corporate Plans and Business Plans of DoA. This should show clearly their core role and work in Agriculture in terms of the outputs, outcomes and impacts of each programme.

## AGRICULTURE PROJECTS

**Agricultural projects are the cutting edge of agricultural development and is a process and systematic tool that need to be followed for better results.**

## PROJECT PLANNING

The Project planning phase in agriculture uses the constraints analysis in the Farming Systems Analysis as the basis of project identification for government interventions. This latest version of what used to be called the Logical Framework in the seventies is now called the Design and Monitoring Framework .It is a well defined demand driven process. As part of the planning process is the Alternative and Cost Benefit analysis to determine the best strategy and viability of projects and this links the farming systems analysis to the project cycle.

## PROJECT IMPLEMENTATION

Project Implementation will depend on implementation planning which should list in a logical sequence all the tasks that needs to be carried out in order to produce the outputs, outcomes and impacts. Every project must have clear targets and identify responsible officers or departments in the implementation plans before funding is released.

The Extension Division is the responsible division of project implementation and they will need the support of subject matter specialists in the implementation of projects and hence it would be great if all responsible divisions in the Economic Planning Unit could take the leading role in the preparation of projects and industry plans and Extension will assist in the identification.

## PROJECT MONITORING AND EVALUATION

Project Monitoring and Evaluation is a very critical part of the process in the project cycle which can only be done properly if targets are clear and responsible officers identified. Monitoring reports is a pre-requisite in the monitoring and effective management of projects. The Monitoring and Evaluation of Projects from an external unit within the organization will keep the implementing arm on their toes at all times. This is why the consolidation of the the monitoring unit in EP&S is very important in terms of improving service delivery.

## AGRICULTURAL CENSUS

The Agricultural Census is a system and process carried out every 10 years to verify the area of crops, number of livestock and farmers and features of the farming systems that should be available with all Extension Officers if they keep records of all the farmers and projects which they supervise. Census figures when completed should be the benchmark in the formulation of agricultural development plans.

## PROCESS MAPS

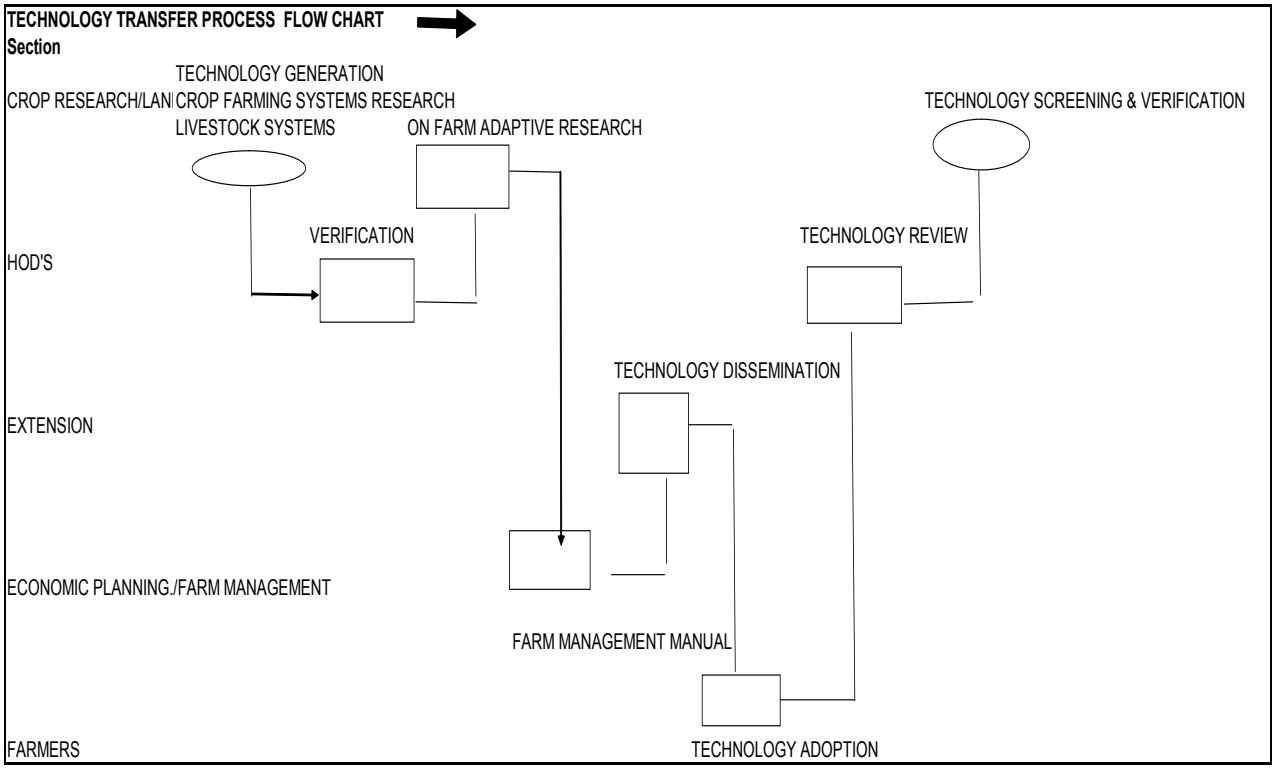
A Process is the transformation of inputs of labor and capital through various activities that needs to be carried out in a logical sequence to achieve outputs, outcomes and impact. There are common process in which all departments in the Department of Agriculture are

linked and what is seen as outputs of certain department are inputs of other department into the production of external outputs. eg. The production of a Better Farm Plan for a farmer will require the input of the Land Use Plan, Agronomic Practices from the Research before the Financial Analysis of the Farmer could be equated.

All divisions in DoA should map out their internal processes and systems that are critical in supporting the core role of DoA in the Technology Transfer Process, the Project Cycle and the Farming Systems Development Process. This will include the Human Resources and Accounts Department and other subject matter specialists who are providing support services to the Research and Extension Divisions.

## THE TECHNOLOGY TRANSFER PROCESS

The generation, development and dissemination of relevant technologies for cropping and livestock systems are the driving force of agricultural development. This involves the Research and the Extension Divisions and is the core business of the Department of Agriculture. Other functional departments and disciplines from agronomists, veterinarians, engineering, farm management and economics in the DoA are involved and are the pillars of the Technology Transfer Process.




The department is so scientific and systematic that new knowledge acquired for the farmers use must be tested and verified through adaptive research before it can be disseminated for public use. Recently, the introduction of potatoes and attempts by DoA to plant NZ potatoes without following the process have resulted in the failure of the crop in the farmers field. Given the changing nature of the bio-socio-economic environment that surrounds agriculture the technology transfer process is dynamic at all times and the need for timely responses will require close monitoring of farming systems information. Impacts of changes in prices and costs of inputs on the profitability of farming systems should be closely monitored in order to maintain the interests of the farmers.

The fact that most farming systems budgets are not properly documented and monitored is of grave concern in the Department of Agriculture. One will wonder as to what is the basis of Extension Officers advice to farmers.

**THE USE OF THE FARMING SYSTEMS DEVELOPMENT APPROACH TOOL BY EXTENSION TO LINK RESEARCH AND FARMERS AND TO DETERMINE KEY RESULTS AREAS OF GOVERNMENT INTERVENTIONS.**

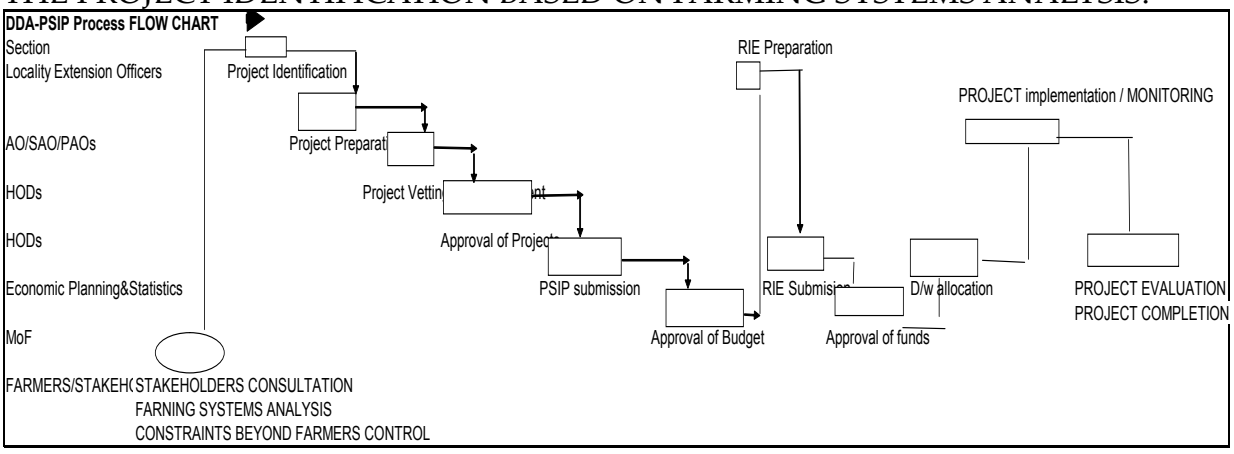
The transfer of information from research to the farmers is supposed to be done through the Farming Systems Development Process where farmers are advised by Extension Officers to adopt sustainable farming practices and search for a Farming System that is complementary sustainable and profitable. The search for a cropping or livestock mix that has market outlets and that it is technically feasible will be the main objective. Issues affecting the profitability of farming systems at macro and micro level would be analyzed in the farming systems analysis. It should be guiding the formulation of relevant policies and forms of government interventions in programs and project as the cutting edge of development.

FSD is an approach to develop farm household systems and rural communities on a sustainable basis. It is basically the adoption of the Farm Management Principles and advocacy of farming as a business where household needs are of paramount importance and should guide the allocation of scarce resources.

Previous development efforts in DoA, including research and extension, were often following "Top Down" supply driven approaches as opposed to demand driven approaches in development planning and implementation. These conventional approaches often did not address the constraints and development potentials of the farm-household systems and rural communities in a comprehensive way. This is one of the main reasons of lack of ownership and project failures in the past.

Projects and programmes are meant to develop farming systems and every project should show clearly how it will influence the profitability of farming systems and the income of households. Therefore the project cycle in terms of the identification of projects should be based on farming systems analysis and focusing on trying to address the constraints that are limiting the production potential of the farming system.

THE PROJECT IDENTIFICATION BASED ON FARMING SYSTEMS ANALYSIS.




The Farming Systems Development Approach has been adopted in most developed countries whose livelihood are dependent on their natural resources and have reaped the benefits of achieving the desired development results.

Generally, Fiji has failed to fully adopt this approach since its introduction in the early eighties and this is evident in the lack of understanding and appreciation of farm management principles by Extension Officers and Farmers.

**THE FORMULATION OF INDUSTRY PLANS /VALUE CHAIN DEVELOPMENT PLANS ARE BASED ON FARMING SYSTEMS ANALYSIS AND OTHER COMMODITY PROFILES AND LAND USE CAPABILITY DATA IN THE DATA BASE OF AGRICULTURE.**

Profitable farming systems are the building block for any value chain development of agricultural commodities. Likewise the viability of all businesses in the value chain driven by the customer needs requires all players to work together and sharing information in order to increase production and adding value to the value chain. The capacity of farmers to increase production and the ability of all players in the value chain to work together in increasing production and adding value of crops on various farming systems is critical. This has been the cause of downfall in the ailing sugar industry where stakeholders have different interests and not working together for the benefit of all.

Every commodity should have an Industry Plan where all issues of the value chain are analyzed and plans formulated to guide the development of the value chain. The PSIP proposals, and projects proposals for the FSP,EPP and ROI should show what they are trying to address in the value chain.

Note that to date there is only one industry plan for rice in the Department of Agriculture and all the other commodities will need to be developed. This is one of the main reason why funds and projects could not be synergized and coordinated to address value chain development of various commodities.

**THE INTEGRATION OF COMMODITY OR INDUSTRY PLANS INTO RURAL DEVELOPMENT PLANS AND SYNERGY OF DoA AND RURAL DEVELOPMENT IN DEVELOPING RURAL COMMUNITIES AND VALUE CHAIN.**

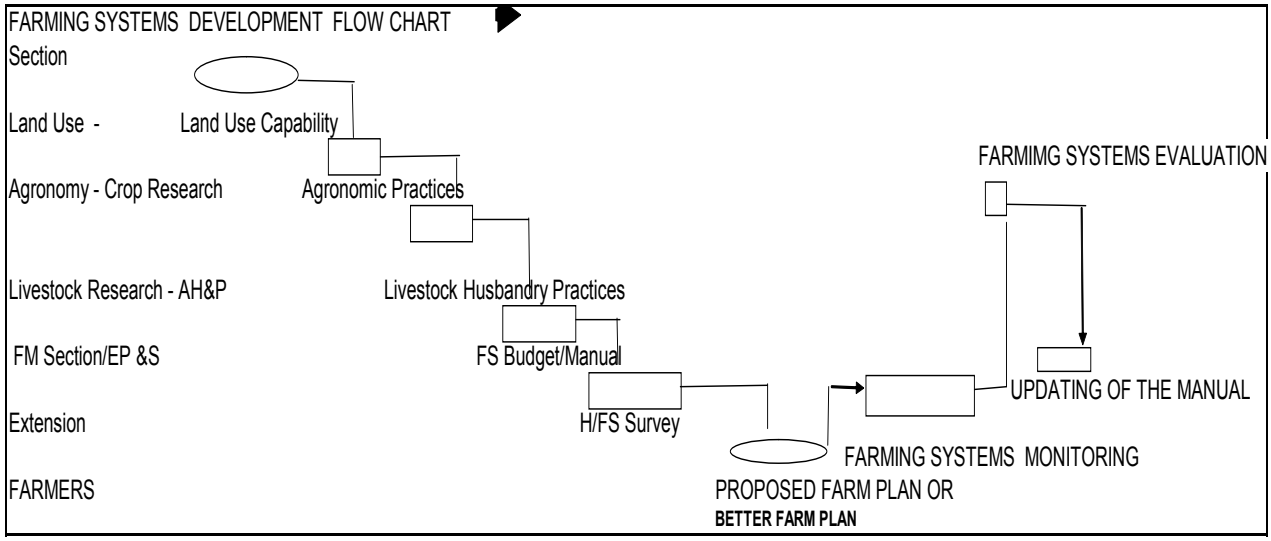
The industry plans of various commodities will need to identify areas of production and infrastructure support systems, marketing systems and value addition of commodities in the value chain. With a common plan in place various government departments should be made to identify what they could do in the development of the value chain.

**THE DEPENDENCY SYNDROME AND ITS RELATIONSHIP TO SUBSISTENCE FARMING.**

The mind set causing the Dependency Syndrome and continuous hunger for handouts from the rural farming communities is the biggest challenge to change in DOA if we are to make a difference. Note that to date 80% of our farmers are classified as subsistence and would need to be changed. The endless requests for assistance in the direct costs of their farming business is indicative of the fact that farming is still treated as just a way of life. Farmers farming as a business should accept the fact that they have to meet the direct costs of their business like fertilizers since it is directly related to their productivity and hence profitability of their business.

**FARMING SYSTEMS DEVELOPMENT APPROACH AS THE TOOL FOR EXTENSION.**

The farm planning / farming systems analysis process is a systematic tool which extension officers should follow in advising farmers on how to improve their farming systems and livelihood and this will result in the production of a Better Farm Plan. This report should also reveal constraints of farming systems and poor practices of farmers that are supposed to be addressed by extension programmes and government projects for the continuous development of farming systems.




Therefore the identification of projects and focus of projects are supposed to be based on farming systems analysis with the overarching goal of improving the profitability of farming systems. To date farming systems budget of most cropping and livestock systems in Fiji are not documented.

There is no other better tool available for Extension Officers to use in advising farmers systematically and holistically other then the Farm Planning Process used in the Farming Systems Analysis. The first step is the resource inventory which when properly analyzed will clearly show constraints that are limiting the production system. 1.5.4 When solutions are identified and alternative analysis carried out to determine the best combinations this will form the basis of the Proposed Better Farm Plan. This is the process that all Extension Officers are now required to follow in advising farmers.

The updating of Farming Systems Information for the effective management of the agricultural sector can clearly show income level and food supply of different farming systems from different divisions. This would show who are the food insecure people, where are they and why and will assist in monitoring our contribution in the alleviation of poverty as stipulated in the Strategic Framework for Change.

Better Farm Plans must be based on verifiable FSD data that should be properly documented in the Farm Management Manual and verified by those involved in the technology generation.ie. Research. It has been noted that Extension Officers have been cutting corners and using unverified data and different ways in how they appraise and advise farmers. In relation to the ISP, EPP and ROI project proposals are more like better farm plans for individuals when they are meant to be submissions proposing government interventions to a group of farmers who are facing similar limitations in their farming systems.

Currently, most Farm Plans are done without alternative analysis hence the opportunity costs of the farmers are not properly analyzed to ensure the maximization of the profitability of farming business. Why should we waste the farmer's time if we cannot show them anything better than what they are currently doing? Farmers deserve the best possible advice and any advice offered should be analyzed in the context of how it will influence the profitability of their farming businesses.

The biggest question to ask now is how are we are advising our farmers if we do not know the profitability of the different systems and what is the basis of projects that are implemented in the Department of Agriculture and how they will influence the household income of communities.

**THE DEMAND DRIVEN APPROACH TO GUIDE AGRICULTURAL DEVELOPMENT.**

In response to the Agriculture Scam the Department of Agriculture had introduced the Demand Driven Approach following systems and processes that are aimed to improve accountabilities and transparencies. These included the Logical Framework or the Design Monitoring Framework and the Farming Systems Development Approach which staffs should appreciate and realize their direct relationship.

**WEAKNESSES OR LOOP HOLES IN DDA IMPLEMENTATION**

Currently project proposals submitted under the DDA programmes are just like a Farm Plan for individuals and failing to show what will benefit the general public. Projects are basically government interventions aimed to address specific constraints which are beyond the control of farmers or towards showcasing or modeling value chain development from which farmers can benefit.

The new Demand Driven Approach can be easily turned into another major scam if we are not going to comply with the DMF and FSD processes and systems. It has been observed that some old habits were creeping in which management overlooked due to non compliance to the process of DMF. Recently training had been conducted to clarify the process and systems which Extension would need to take ownership from now onwards.

In view of the above practices one can obviously see that most decisions and advises are based on assumptions or hear say facts .The failure of most agricultural projects and farmers are either due to the mono-cropping approach or poor identification of constraints that should warrant government interventions. These include the ailing Sugar Industry, Rice Industry, Coconut Industry and Dairy Industry etc.

**NEED FOR FARM MANAGEMENT FARMING SYSTEMS DEVELOPMENT APPROACH TRAINING**

The need for Farm Management training course for Agriculture Technical officers and other Stakeholders has been around for a long time. This is clearly evident from the different types of Farm Reports which are produced within and are of unsatisfactory standards.

The Farming Systems Development Approach has been advocated for decades by FAO; however the DOA has somehow not fully adopted the requirements and on the contrary has bogged itself with the commodity approach in development of prioritized crops with significant market opportunities. This has resulted in our narrow focus with regards to commodity development where mono cropping has been encouraged even though this has been proven non-sustainable.

As a result of this narrow focus, the agriculture sector has failed to effectively monitor and respond to the impacts of input and output price changes in a timely fashion as currently evident with the Sugar Industry. Moreover, we must realize that this also means lost opportunities and loss of livelihood for households.

In addition to this the DOA must realize that the Farming Systems Development Approach requires the integration of relevant stakeholders. This basically addresses the technology transfer process which requires the input by all divisions including Research and Extension i.e. Crop and Livestock, Economic Planning & Statistics, Land Use Planning and Farm Management.

**FARM MANAGEMENT MANUAL**

1.6.10 The current Farm Management Manual is focusing on commodity development only and falling short in the sense that it provides only gross margin analysis of all commodities. There is no Farming Systems Budget to show the profitability of different Farming Systems which should be representative of the Household income level in the different localities.

**FAILURE OF THE COMMODITY APPROACH TO AGRICULTURAL DEVELOPMENT.**

The commodity approach used in DOA had led to the lack of monitoring of our Farming Systems and failure of projects. This has resulted in our sole reliance on Household Income Expenditure Survey or National Agriculture Census to ascertain the level of income of our farmers. This exercise is carried out by the Bureau of Statistics and DOA once every ten years to verify some data that should be regularly updated by implementing agencies like DOA.

The inconclusive approach and different methodology used in the current farm planning process coupled with the lack of unverifiable farming systems information is indicative of the standard and poor service delivery of Extension Advisory Services.

Currently some project proposals are out of line as constraints are not clearly identified since FSD is not properly followed. Consequently most projects are addressing constraints within the control of farmers and not the ones that are beyond the control of farmers and benefiting the general public. This simply means that we are still encouraging the HANDOUT mentality that led to the then Agriculture Scam.

**CONCLUSION**

In view of the systems and process it could be concluded that Agriculture is not only scientific but very systematic in trying to meet the continuous changing needs of farmers. It is therefore important for all staffs to be conversant to master these systems and understand the processes for the development of the Agricultural Sector.

APPENDIX 4

# WEIGHTS AND MEASURES

## THE S.I SYSTEM

- Introduction
- S.I Units
- The prefixes of S.I Units

## AGRICULTURAL APPLICATIONS OF THE S.I SYSTEM

- Agricultural chemicals
- Animal remedies
- Fertilizers

## METRIC AND IMPERIAL CONVERSIONS

- Area
- Density
- Energy
- Length
- Mass
- Mass per unit area
- Temperature
- Velocity
- Volume
- Volume per Unit
- Volume per unit

## MISCELLANEOUS MEASURES

- Cost conversions
- Distance
- Rainfall
- Temperature
- Velocity
- Volume
- Mass per unit area

## THE S.I SYSTEM

### Introduction

The International system (SI) of units is used in most countries of the world. This uniformity of measure is preferable to several different systems, which require tedious conversions.

It is clumsy to think in the old imperial system and convert into metric or vice versa. It is better to "Think Metric" in the first place.

This section is designed to assist those people who have not completely changed over to the metric system

### S.I Units

Only a small proportion of the total. SI Units are needed for everyday use. These are:

| Quantity | Unit | Symbol |
|---|---|---|
| Length | Millimetre | mm |
| | Centimeter | cm |
| | Metre | m |
| | Kilometre | km |
| Area | Square centimeter | $cm^2$ |
| | Square metre | $m^2$ |
| | Hectare | ha |
| Volume | Cubic centimeter | $cm^3$ |
| | Cubic metre | $m^3$ |
| | Millilitre | $m^1$ |
| | Litre | 1 or litre |
| Mass (Weight) | Gram | G |
| | Kilogram | Kg |
| | Tonnes | T |
| Velocity | Metre | m/sec |
| | Kilometres | km/h |
| Force | Newton | N |
| Pressure | Kolopascal | kPa |
| Temperature | Degree Cel | |

**The Prefixes of S.I Units**

There is a unit to each quantity – for example the unit in length is the metre. The prefixes 'milli'. 'centi' and 'kilo' denote how many parts of the basic unit a measurement is. For example, a centimeter is one-hundreth of a metre, and a kilometer is one thousand times a metre. All metric units in each quantity are related to each other in multiples of 10. The most common prefixes are:-

| Prefix | Symbol | Meaning |
|---|---|---|
| Mega | M | one million times |
| Kilo | k | one thousand times |
| Hector | h | one hundred times |
| Deca | da | ten times |
| Deci | d | one-Tenth |
| Centi | c | one-Hundredth |
| milli | m | one-thousandth |
| micro | | one-millionth |

**Agricultural applications of the S.I System**

**Agricultural Chemicals**

The tables on agricultural chemicals should list the following information:-
Active ingredient (a.i)
Rates of application, and Net contents

The Active Ingredient statement is expressed in grams per litre (g/L) for liquid formulations (mineral oil a.i. is expressed in m1/L) and as g/kg for solids.
In each case, the percentage figure will also be included, so there should be no confusion.

For example, normal strength 2,4,5-T butyl ester will be shown as:-
"360 g/litre (36%)2,4,5-T butyl ester in the form of an emulsifiable concentrate"

**Animal Remedies**

The majority of animal remedies are sold in metric measures, and most equipment- such as drenching guns, is graduated in the same way. Non-metric equipments should be recalibrated or replaced with correctly calibrated equipment. Note that 1 cc (now written $cm^3$) = 1 ml.

*Various measures you will need to know are:-*

| **Quantity** | **In metric term** |
|---|---|
| Volume of doses | Millimitres (ml) |
| Volume of plunge and shower dips | Litres (l) |
| Weight of ingredients and livestock | Grams(g) & kilograms (kg) |
| Pressure | Kilopascals (kPa) |
| Concentration of dips and drenches | Grams per litre (g/litre) |

If any doubt about what to do, consult your veterinarian.

## Fertilizers

Fertilizers are sold from the works either in 50kg bags or by the tone. Recommendations for applications are given in kilograms per hectare or tones per hectare. An easily remembered conversion is that 1 hundred – weight per acre (cwt/ac) = 125 kilograms per hectare (125kg/ha).

## METRIC AND IMPERIAL CONCERSIONS

Area

| Metric to imperial | Imperial to Metric |
|---|---|
| 1cm² = 1.155 sq.inch | 1sq inch = 6.452 cm² |
| 1m² = 10.76sq.feet | 1sq foot = 0.092 90m |
| 1m² = 1.196 sq.yards | 1sq yard = 0.836 12 |
| 1m² =0.039 54 perch | 1perch = 25.29m² |
| 1m² = 2.471 acres | 1acre = 0.404 7 ha |
| 1km² = 0.386 sq.mile | 1sq.mile = 2.590 km² |
| 1km² = 100h.1ha-1000m²) | 1sq.chain = 400m² |

Quick conversions:

| | | | |
|---|---|---|---|
| Square inches | x 20/3 | = | cm² |
| Square yards | x 5/6 | = | m² |
| Perches | x 25 | = | m² |
| Acres | x 4/10 | = | ha |
| Square miles | x 5/2 | = | km² |

### Density

| **Metric to Imperial** | **Imperial to Metric** |
|---|---|
| 1g/cm² = 0.0361 13 pound/cu.inch | 1 pound/cu.inch = 27.68g/cm³ |
| 1g/cm³ = 62.43 pound/cu.foot | 1 pound/cu.foot – 0.016 02 g.cm³ |
| 1kg/m³ = 0.062 43 pound/cu.foot | 1 pound /cu.foot =16.02 kg/m |
| 1g/litre = 0.160 4 ounce/gallon | 1 ounce/gallon = 6.263 g/litre |
| 1g/litre = 0.010 02 pound/gallon | 1 pound/gallon = 99.78 g/litre |

Quick conversion:

| | | | |
|---|---|---|---|
| Pounds per cubic foot | x 16 | = | kg/m² |
| Ounces per gallon | x 6 | = | g/litre |
| Pounds per gallon | x 100 | = | g/litre |

## Energy

| Metric to Imperial | Imperial to Metric |
|---|---|
| 1kj/kg = 0.108 3 kilocalories/pound | 1 kilocalories/pound = 9.230 kj/kg |
| 1kj =0.0238 8 kilocalories | 1 kilocalories = 4.187 kj |
| 1kj = 0.948 Btu | 1 Btu = 1.06 Kj |
| 1kw = 1.341 horsepower | 1 horsepower = 0.754 7 kw |
| 1Mj = 9.48 x 103 therm | 1 therm = 106 Mj |

Quick conversions:

| | | | |
|---|---|---|---|
| Kilocalories | x | 4 | = Kj |
| Hozpower | x | ¾ | = Kw |

Note : the watt is the power used when work is done or energy expended at the rate of one joule per
second.

## Length

| Metric to imperial | Imperial to Metric |
|---|---|
| 1mm = 0.039 37 inch | 1 inch = 25.4mm |
| 1cm =0.0393 7 inch | 1 inch = 2.54cm |
| 1m =3.281 feet | 1 foot = 0.304 8 m |
| 1m =0.049 71 chain | 1 inch =20.12m |
| 1km =0.621 4 mile | 1 inch =1.609km |
| 1m =0.004 971 furlong | 1 inch =201.2m |

**Quick conversions:**

| | | | |
|---|---|---|---|
| Inches | x 10/4 = | centimetres | |
| Chains | x 20 | = | metres |
| feet | x 3/10 | = | meters |
| miles | x 8/5 | = | kilometers |
| yards | x 9/10 | = | meters |

## Mass

| Metric to imperial | Imperial to Metric |
|---|---|
| 1g =0.035 27 ounce | 1ounce =28.25g |
| 1g = 0.002 204 pound | 1 pound = 453.6g |
| 1kg =2.204 6 pounds | 1 pound = 0.453 6 kg |
| 1kg = 0.0157 5 stone | 1 stone = 6.350 4 kg |
| 1kg =0.019 68 hundred weight | 1 hundred weight = 50.803kg |
| 1t = 984 2 long ton | 1 long ton = 1.016 t |
| 1t =1.102 3 short tons | 1 short ton = 0.907 2t |
| (t = 1 000kg) | |

**Quick conversions:**

| | | | |
|---|---|---|---|
| Ounces | x 30 | = | g |
| Pounds | x 49 | = | kg |
| Hundred weights | x 50 | = | kg |
| Long tons | x 1 | = | t |

**Mass Per Unit Area**

| Metric to imperial | Imperial to Metric |
|---|---|
| 1g/m² = 0.029 49 ounce/sq.yard | 1 ounce/sq.yard = 33.91g/m² |
| 1g/m² =9.922 pounds/acre | 1 pound/acre = 0.1121 g/m² |
| 1kg/ha= 0.8922 pound/acre | 1 hundred weight/acre = 0.125 5 t/ha |
| | 1 ton/acre = 2.5t/ha |

**Quick conversions:**

| | | |
|---|---|---|
| Ounces per square yard | x 100/3 | = g/m² |
| Pound per acre | x 11/100 | = g/m |
| Pounds per acre | x 11/10 | = kg/ha |
| Tons per acre | x 10/4 | = t/ha |

**Temperature**

Temperature is measured in degree Celsius. To convert temperatures:
9/5 x degree Celsius + 32 = degrees farenheit
9/9 x (degree Fahrenheit – 32) = degrees Celsius

**Velocity**

| Metric to imperial | Imperial to Metric |
|---|---|
| 1m/s =3.281 feet/second | 1 foot/second = 0.3048m/s |
| 1m/s =2.237 miles/second | 1 mile/hour = 0.44m/s |
| 1km/h = 0.911 3 foot/second | 1 foot/second = 1.0972km/h |
| 1km/h = 0.6214 mile/hour | 1 mile/hour = 1.609km/h |

Quick conversions:

| | | | |
|---|---|---|---|
| Feet per second | x | 3/10 | = m/s |
| Miles per hour | x | 8/5 | = km/h |

**Volume**

| Metric to imperial | Imperial to Metric |
|---|---|
| 1cm³ = 0.061 cubic inches | 1 cubic inch = 16.387cm³ |
| 1m³ = 35.32 cubic foot | 1 cubic foot = 0.02832 cm³ |
| 1m³ = 1.308 cubic yds | 1 cubic yard = 0.7646m³ |
| 1m¹ =0.035 2 fluid ounces | 1 fluid ounce = 28.41ml |
| 1litre=1.760 pints | 1 pint = 0.5683 litre |
| 1 litre = 0.220 gallon | 1 gallon = 4.546 litres |
| 1litre =0.035 31 cubic feet | 1 cubic foot = 28.3167 litres |

**Quick conversations:**

| | | |
|---|---|---|
| Cubic inches | x 16 | = $cm^3$ |
| Fluid ounces | x 30 | = ml |
| Cubic inches | x 16 | = $cm^3$ |
| Pints | x 6/10 | = litres |
| Cubic feet | x 3/100 | = $m^3$ |
| Gallons | x 9/2 | = litre |
| Cubic yards | x ¾ | = $m^3$ |

**Volume per unit area**

| Metric to imperial | Imperial to Metric |
|---|---|
| 1 millilitre/ha = 0.014 | 1 fluid ounce/acre = |
| Fluid/ounce/acre | 70.2 millitres/ha |
| 1 litre/ha = 0.7121 pint/acre | 1 pint/acre = 1.404 |
| 1 litre/ha = 0.809 | Litres/ha |
| Galloon/acre | 1 gallon/acre = 11.23 |
| | Litres/ha |

**Volume per unit time** (Volume rate of flow)

| Metric to imperial | Imperial to Metric |
|---|---|
| 1m3/s = 35.31 cubic feet/second | 1 cubic foot/second = 0.028 32m3/s |
| 1m3/h = 0.009 810 cubic foot/sec | 1 cubic foot/second = 101.0m3/h |
| 1m3/h = 219.98 gallons/hour | 1 gallon/hour=0.004 546m3/h |
| 1litres/s = 0.035 31 cubic foot/second | 1 cubic foot/second= 28.32 litres/s |
| 1litre/h = 0.003 666 gallon/minute | 1 gallon/minute = 272.8 litres/h |
| 1litre/h =0.220 gallon/hour | 1 gallon/hour = 4.546 litres /h |

**Quick conversions:**

| | | | |
|---|---|---|---|
| Gallons per hour | x | 9/2000 | = m3/h |
| Gallons per minute | x | 3/11 | = m3/h |
| Gallons per hour | x | 9/2 | = litres/h |
| Cusecs | x | 30 | = litres/s |

(1 cumec = 2 cubic metre per second)

**Miscellaneous measure**

COST CONVERSIONS

| | | |
|---|---|---|
| Cost per kilogram | = | Cost per pound x 2.2 |
| Cost per kilogram | = | Cost per hundredweight/50 |
| Cost per tone | = | Cost per ton x 1 |
| Cost per litre | = | Cost per gallon/4.5 |
| Cost per hectare | = | Cost per acre x 2.5 |
| Cost per metre | = | Cost per yard x 1.1 |
| Cost per metre | = | Cost per chain/20 |
| Cost per kilometre | = | Cost per mile/1.6 |

**Distance**
1 international nautical mile = 1 852m

**Rainfall**
10 points = 2.54mm
1 inch = 25.4mm

**Temperature**

| | |
|---|---|
| Freezing point | = 0 degree Celsius |
| Blood heat | = 26.6 degrees celsius |
| Cold water (tap) | = 10 degrees celsius |
| Warm water | = 50 degrees celsius |
| Hot water | = 70 degrees celsius |
| Boiling water | = 100 degrees celsius |
| Absolute temperature | = degrees Celsius + 273.16 |

**Velocity**

1 knot = 1 nautical mile per hour = 0.514 m/s

**Volume**

| | | |
|---|---|---|
| 1 teaspoon | = | 305ml |
| 1 desert spoonful | = | 7ml |
| 1 tablespoonful | = | 14ml |
| 1 milk bottle | = | 600ml |
| 1large milk bottle | = | 740ml |
| 1 5 galloon drum | = | 22 litres |
| 1 44 gallon drum | = | 200 litres |

**Mass per unit area**

| | | |
|---|---|---|
| 1 pound per acre | = | 1.1kg/ha |
| 1 hundred weight/acre | = | 125kg/ha |
| 1 ton per acre | = | 2.5 t/ha |

APPENDIX 5

# FARM MACHINERY

**HORSE POWER TERMS**

**ESTIMATES FUEL & OIL CONSUMPTION OF TRACTORS**

**OIL CONSUMPTION**

**WORK CAPACITY OF FARM MACHINERY & IMPLEMENTS**

**FIELD CAPACITY & EFFICIENCY**

**COSTS OF OWNING & OPERATING FARM MACHINERY**

- **Fixed costs of ownership**
- **Variable Costs**
- **Example costing**

## ESTIMATED FUEL AND OIL CONSUMPTION OF TRACTORS

The average fuel consumptions per kw/hour shown in the table is for new tractors. The rate for older tractors may be higher. The average load on the engine varies according to the way the machine is used, the size and type of the implement attached, speed of travel and condition of the soil.

The fuel consumption per kw/hour increases as the load on the engine decreases.

Average specific fuel consumption per kw/hour for a sample of new tractors

Type of engine and fuel

| **Engine loading** | **Petrol** | **Diesel** |
|---|---|---|
| **% of max. power** | **litres/kwh** | **litres/kwh** |
| 100 | .261 | .180 |
| 75 | .292 | .193 |
| 50 | .366 | .217 |
| 35 | .468 | .254 |
| 25 | .573 | .319 |

Approximate fuel consumption in litres per hour can be estimated y multiplying S.F.C by power in kw produced at a particular engine loading.

## OIL CONSUMPTION

Average consumption in tractors is 2.5 to 3 per cent of the fuel consumption. The engine oil may be changed every 250 hours and transmission oil may be changed every 1,000 hours. Oil filters are usually changed at each oil change.

# FUEL CONSUMPTION IN LITRES/HR FOR DIFFERENT SIZES AND LOADS OF TRACTORS

## Type of Maximum Engine
## Load of Engine (% of maximum power)

| Engine (h.p) | Power (kw) | 75% Gls/hr,1/hr | | 50% Gals/hr,1hr | | 35% Gals/hr,1hr | | 25% Gals/hr,1hr | |
|---|---|---|---|---|---|---|---|---|---|
| 30 | 22.4 | 1.93 | 8.77 | 1.62 | 7.36 | 1.45 | 6.59 | 1.27 | 5.77 |
| 35 | 26.1 | 2.26 | 10.27 | 1.89 | 8.59 | 1.69 | 7.68 | 1.48 | 6.81 |
| 40 | 29.8 | 2.58 | 11.73 | 2.16 | 9.82 | 1.93 | 8.77 | 1.69 | 7.68 |
| 45 | 33.5 | 2.90 | 13.18 | 2.43 | 11.05 | 2.17 | 9.91 | 1.90 | 8.63 |
| 50 | 37.3 | 3.22 | 14.64 | 2.70 | 12.27 | 2.42 | 11.01 | 2.11 | 9.59 |
| 55 | 41.0 | 3.55 | 16.14 | 2.97 | 13.50 | 2.66 | 12.09 | 2.32 | 10.54 |
| 60 | 44.7 | 3.87 | 17.59 | 3.24 | 14.73 | 2.90 | 13.18 | 2.54 | 11.55 |
| 65 | 48.5 | 4.19 | 19.05 | 3.51 | 15.96 | 3.14 | 14.27 | 2.75 | 12.50 |
| 70 | 52.2 | 4.52 | 20.55 | 3.78 | 17.18 | 3.38 | 15.37 | 2.96 | 13.45 |
| 75 | 55.9 | 4.84 | 22.00 | 4.05 | 18.42 | 3.62 | 16.46 | 3.17 | 14.41 |
| 80 | 59.6 | 5.16 | 23.46 | 4.32 | 19.64 | 3.86 | 17.54 | 3.38 | 15.37 |
| 85 | 63.4 | 5.48 | 24.91 | 4.59 | 20.88 | 4.12 | 18.73 | 3.59 | 16.32 |
| 90 | 67.1 | 5.80 | 26.37 | 4.86 | 22.09 | 4.35 | 19.78 | 3.80 | 17.27 |
| | (DIESEL) | | | | | | | | |
| 30 | 22.4 | 1.28 | 5.82 | 0.96 | 4.36 | 0.79 | 3.59 | 0.71 | 3.23 |
| 35 | 26.1 | 1.50 | 6.82 | 1.12 | 5.09 | 0.92 | 4.18 | 0.82 | 3.73 |
| 40 | 29.8 | 1.71 | 7.77 | 1.28 | 5.81 | 1.05 | 4.78 | 0.94 | 4.27 |
| 45 | 33.5 | 1.92 | 8.73 | 1.44 | 6.55 | 1.18 | 5.36 | 10.6 | 4.82 |
| 50 | 37.3 | 2.14 | 9.73 | 1.60 | 7.27 | 1.31 | 5.95 | 1.18 | 5.36 |
| 55 | 41.0 | 2.35 | 10.68 | 1.76 | 8.00 | 1.44 | 6.55 | 1.29 | 5.86 |
| 60 | 44.7 | 2.56 | 11.64 | 1.92 | 8.73 | 1.58 | 7.18 | 1.41 | 6.41 |
| 65 | 48.5 | 2.78 | 12.64 | 2.08 | 9.45 | 1.71 | 7.77 | 1.53 | 6.96 |
| 70 | 52.2 | 2.99 | 13.59 | 2.24 | 10.18 | 1.84 | 8.36 | 1.65 | 7.50 |
| 75 | 55.9 | 3.21 | 14.59 | 2.40 | 10.91 | 1.97 | 8.95 | 1.76 | 8.00 |
| 80 | 59.6 | 3.42 | 15.55 | 2.56 | 11.64 | 2.10 | 9.55 | 1.88 | 8.55 |
| 85 | 63.4 | 3.63 | 16.50 | 2.72 | 12.36 | 2.23 | 10.13 | 2.00 | 9.09 |
| 90 | 67.1 | 3.85 | 17.50 | 2.88 | 13.09 | 2.36 | 10.72 | 2.12 | 9.64 |
| 95 | 70.8 | 4.06 | 18.46 | 3.04 | 13.82 | 2.49 | 11.32 | 2.23 | 10.14 |
| 100 | 74.6 | 4.28 | 19.46 | 3.20 | 14.55 | 2.63 | 11.95 | 2.35 | 10.63 |
| 105 | 78.3 | 4.49 | 20.41 | 3.36 | 15.28 | 2.76 | 12.54 | 2.47 | 11.23 |
| 110 | 82.0 | 4.70 | 21.37 | 3.52 | 16.00 | 2.89 | 13.14 | 2.59 | 11.77 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 115 | 85.7 | 4.92 | 22.37 | 3.68 | 16.73 | 3.02 | 12.73 | 2.70 | 12.27 |
| 120 | 89.5 | 5.13 | 23.32 | 3.84 | 17.46 | 3.15 | 14.31 | 2.82 | 12.82 |
| 125 | 93.2 | 5.34 | 24.27 | 4.00 | 18.18 | 3.28 | 14.91 | 2.94 | 13.36 |
| 130 | 96.9 | 5.56 | 25.27 | 4.16 | 18.91 | 3.41 | 15.51 | 3.06 | 13.91 |
| 135 | 100.7 | 5.77 | 26.23 | 4.32 | 19.64 | 3.54 | 16.10 | 3.17 | 14.41 |
| 140 | 104.4 | 6.00 | 27.28 | 4.48 | 20.37 | 3.68 | 16.73 | 3.29 | 14.95 |

## WORK CAPACITY OF FARM MACHINERY AND IMPLEMENTS

Cultivation

**Harvesting:**

Area covered by cultivation implements in a given time depends on :-
Size of implement
Size of traction unit
Nature of county – general steepness of the contour
Type and condition of soil - compare light, stony, heavy and clay soil. In the wet or dry condition

**Type of work:**

Breakage and general skill of operator. An experienced man knows the speed at which he gets maximum use out of the implement

**Size and shape of paddock:**

Area covered by harvesting machinery in a given time depends on:-

1. bulk of the crop-heavy or light yields
2. type of crop-rice or peas or clovers etc
3. condition of crop - ease of threshing – lodged rice
4. weather - hot,dry, vs damp and cool
5. whether the crop has been windrowed or is being direct headed
6. nature of ground surface-flat or sloping, smooth or rough.

## FIELD CAPACITY AND EFFICIENCY

Field capacity is a measure of the relative productivity of a machine under field conditions. It accounts for failure to utilize the theoretical operating width of the machine, operator capability and habits, operating policy and field characteristics.

The following activities accounts for majority of the time loss in the field:-
Turning and idle travel
Materials handling (e.g seed, fertilizer, chemicals, water, harvested materials)
Cleaning clogged equipment
Machine adjustment
Lubrication and refueling over daily service
Waiting for other machines

**Other filed time interruptions:**

Travel to or from a field, major repairs, preventative maintenance, and daily service activities are not included in field time or failed efficient. Field efficiency is not a constant for a particular machine, but caries with size and shape of the field, pattern of field operating,

crop yield, moisture and crop conditions.

The calculation of depreciation is an estimate. It is based on three factors, one of which is known – cost price – and two of which are unknown – life of the asset and its residual or scrap value.

If a tractor is purchased for $10,000 then, in order to calculate depreciation, an estimate must be made of its life and residual value. There are a variety of approaches that can be adopted in depreciating assets- the three most common methods are outlined.

**Straight Line Method**
Here a constant amount will be depreciated each year. If the estimated residual value is $1000 then the annual depreciation charge will be:

$$= \frac{\text{Cost Price – Residual Value}}{\text{Estimated Life}}$$

$$= \frac{\$10{,}000 - 1000}{4}$$

= $2,250 per annum

An equal charge of $ 2250 is made against profits in each of the year 1-4. At the end of its anticipated useful life the tractor is reduced to a book value of $1000.

**Reducing Balance Method**
Charging depreciation in equal installments, although simple, does not correspond with reality especially in the case of assets like tractors. The fall in value tends to be greater in the early years of its life. This is particularly important if one bears in mind that maintenance expenditure will tend to increase as the machine ages. So a heavier depreciation charge in the early years will offset low repairs and maintenance charges then, while heavier repair and maintenance charges in the later years can be set against a lower depreciation charge giving a fairly even overhead cost over its life.

**Machine Hour Method**
The life of a machine like a tractor related more closely to usage than times so greater accuracy still can be obtained by relating the depreciation charge to usage.

If the tractor is estimated to have a life of say 2000 hours and it is used as follows: year 1 – 1800 hrs year 2-1000hrs, year 3-2000 hrs and year 4-1200 hrs, then the depreciation will be spread over the four years as follows:-

Year 1 - $2700
Year 2 - $1500
Year 3 - $3000
Year 4 - $1800

This method is significant is that the depreciation charge is a variable cost, varying directly with usage, and not a fixed cost as in the previous cases.

**Interest**
This is a charge for the used of money invested in farm machinery.

Annual interest over the working life of farm machinery is calculated by adding the initial purchase price and trade –in value, divided by 2 and multiplying the results by the current bank interest rate.

$$\text{Annual interest} = \frac{(\text{Initial Cost} + \text{Trade-in-value})}{2} \times \frac{\text{I.R}}{100}$$

**Shelter**
Provision of adequate shelter may be expected to increase the life of special farm machinery by up to 10% which should also be reflected in the trade –in-value.

**Insurance**
With engine-functioned farm machinery such as tractors auto header etc. an allowance should be made for actual comprehensive insurance charge.

**Operating Costs**
These costs vary considerably according to the amount of machinery use throughout the year and include:-

**Lubrication**
It includes labour and lubricant (oil and grease), may be expressed as a percentage of initial cost. Actual amounts and charges should be used as a base.

**Labour and Fuel**
Costs may vary and should be calculated according to local rates.

**Repairs**
It varies considerably according to such factors as annual usage, age and complexity of equipment and type of working conditions experienced.

**Example costing for farm machinery**

To illustrate the costs associated with farm machinery the following examples give some assistance. It involves the costing of various sizes of tractors.

**Example 1**

| | 1 | 2 | 3 |
|---|---|---|---|
| Model…….....…… | MF240 | | MF265 |
| MF174 | | | |
| Tractor Cost……..….. | 17000 | 18300 | 2000 |
| Implement…….. | 1500 | 2000 | 4000 |
| **Total** | **$18500** | **$20300** | **$24000** |

**FIXED COST ($ per hour)**

| | | | |
|---|---|---|---|
| Depreciation | 1.74 | 1.85 | 2.19 |
| Interest on capital….. | 1.00 | 1.10 | 1.30 |

| | | | |
|---|---|---|---|
| **VARIABLE COST ($ per hour)** | | | |
| Maintenance | 1.85 | 2.03 | 2.40 |
| Fuel oil & lubricant | 3.57 | 5.43 | 7.70 |
| Operator's wages…. | 1.50 | 1.50 | 1.50 |
| TOTAL HOURLY COST | $9.66 | $11.91 | $15.09 |

**Basis of calculation**
Current costings of machines and implements have been used in the calculation.

**Performance rate of tractors**
Number of working hours/annum – 1200 hours

**Life expectancy**
Maintenance – based on 10% initial outlay. The hourly rate is arrived at the dividing the outlay by life expectancy which is 10,000 hours total; (e.g. $18500 divided by 10,000 hours = $1.85) Interest on capital – using 13% per annum. The hourly rate is arrived at by dividing the above figure by the number of working hours p.a

APPENDIX 6A

# FARM BUDGETING

## FARM BUDGETING

A budget is a financial plan for a future year or period which endeavor to forecast the effect of the farmer's programme. Budgets are an invaluable tool which may be used to

i. Evaluate the cumulative effect of all farm decisions.

ii. Indicate the likely profit for the year.

iii. Assist in the allocation of usually limited funds to best use.

iv. Indicate the working capital requirements

v. Assist farmers to formulate plans to meet their individual goals and to weigh up alternative plans.

vi. Form the basis for financial control system that enable farmers to proceed with great certainty.

In order to budget effectively an adviser must firstly determine the goals of the farmer, and the needs of his family, Secondly he must be thoroughly aware of the resources which are available to the farmer. He must also determine the amount of capital that is available both on short and long term. He must know the farm and proposed farming program. To prepare a budget the adviser must :-

i. Inspect the farm thoroughly, checking on areas, soils, crops, stock numbers and the major strengths and limitations of the property.

ii. Ensure that he understands the farmer's goals, his limitation - obtain correct information.

iii. Have a stock of plants and machineries with its condition and useful life over the years.

iv. Prepare a management report for the Farm as a holistic approach.

***The Livestock Programme :***

a) The Livestock policy

b) Stock numbers

c) Actual performance in terms of mortality rate, milk production, growth rates.

d) Husbandry details, grazing management, mating time, kidding, supplementary feeding etc.

e) Details of sales. (Past and present sales records)

***Pasture Programme***

a) Pasture areas, type of pasture and condition.

b) Stock carrying capacity.

c) Pasture renewal, topdressing and weed control.

*Cropping Programme*

a) Crops grown, areas, rotation.

b) Yields - previous crop yields and the expected yield of existing crops.

c) Crops husbandry, cultivation practice, sowing dates, crop maintenance and harvesting.

d) Timing of operation.

e) List the maintenance requirements of the farm in building, fencing, access way, water supply, drainage, plant and machinery.

f) List the development proposals and the other of priority.

g) List the labour available, the amount of work involved, and the capacity of available labour to complete the work.

h) Thoroughly understand the market requirements, and be familiar with market prices and trends.

**ENTERPRISE BUDGET**

While enterprise analysis is an evaluation of past performance, enterprise budgeting is used to make an assessment of the expected profitability of a proposed enterprise. Enterprise budgets provide the basis for planning the next season's activities. Unlike enterprise profitability analysis where actual/prevailing prices and yields are used, enterprise budgeting calls for estimates of projected yields, prices, costs and input use. Enterprise budgeting is similar to enterprise analysis in format and presentation. Enterprise budgeting consists of four parts:

i. Gross income

ii. Variable costs

iii. Fixed costs

iv. Measure of enterprise profitability

Each type of crop or livestock that can be grown is an enterprise. Enterprise budgets can also be constructed for different levels of production or types of technology. These budgets are more often called "activity budgets". There can be more than one budget for a given enterprise.

An enterprise budget can be calculated on a per unit basis, such as a hectare or acre of land or head of livestock, for either one year or one production period. The base unit, however, is typically a single unit. Using common units allows for easy comparison between different enterprises.

Enterprise budgets can be used for comparing the profitability of alternative enterprises to be proposed on a farm and are useful in developing a whole farm plan. The estimated profit from a given enterprise can be compared against the estimated profit from other enterprises. It is used to select the most profitable enterprises to engage in. Once completed,an enterprise budget contains the data needed to compute average cost of production, the break-even price and the break even yield.

Note that Gross Margin (Chapter 9) is derived is difference between gross income and total variable costs whilst Enterprise profit is the return after taking into account the allotted fixed costs.

Farm Planners should remember that a change in gross margin can result from any combination of changes with respect to the:

- selling price of the produce;
- costs of production;
- level of production;
- level of input use;
- Variations in the product mix (e.g. other enterprises).

***An Example of an Enterprise Budget -***

***1ha Watermelon under Mechanized Farming Systems***

| *Item* | *Unit* | *Quantity* | *Price ($)* | *Amount ($)* |
|---|---|---|---|---|
| ***Watermelon Sales*** | kg | 20,000 | | |
| Marketable 90% | kg | 18000 | 1 | 18000 |
| ***Variable Costs*** | | | | |
| Poultry Manure | kg | 10,000 | 3.5/25kg | 1400 |
| NPK | kg | 200 | 51.88/25kg | 415.04 |
| Urea | kg | 100 | 76.04/40kg | 190.10 |
| Kocide | kg | 0.80 | 35.65/500g | 57.04 |
| Seeds | kg | 2.00 | 5.5/10g | 1100.00 |
| Land Preparation | hour | 14.5 | 40 | 580 |
| Labour | personday | 75 | 20 | 1,500 |
| Transport | trip | 4 | 500 | 2000 |
| ***Total Variable Costs*** | | | | ***$7,242.18*** |
| ***Gross Margin*** | | | | ***$10,757.82*** |
| | | | | |
| ***Fixed Costs*** | | | | |
| Storage Costs | | | | 200 |
| Land Rent | | | | 320 |
| Water Bill | | | | 200 |
| ***Tota Fixed Costs*** | | | | ***$720.00*** |
| | | | | |
| ***Total Operating Costs*** | | | | ***$7,962.18*** |
| | | | | |
| ***Profit*** | | | | ***$10,037.82*** |

The enterprise budget provides the decision-maker with a much clearer picture of how costs are composed. It can be used to assess both technical and financial performance of the enterprise.

## BREAK-EVEN BUDGET

Break-even budgeting is a technique for studying the relationship between costs and income at different levels of production. A break-even budget estimates the maximum acceptable level of a cost item or alternatively, the minimum acceptable level of income given an estimated level of cost.

In other words, it looks at the scale of the enterprise when income equals cost. At this point, profit or gross margins are zero. The results obtained from actual farm conditions are often very different from the values included in the enterprise budget. Yields and output prices often vary considerably in reality because of changes in many factors. It is, therefore, useful to determine the minimum yield and product price required that enables the farmer to recover the variable and total costs incurred in farm enterprise production. The information included in enterprise analyses can be used to perform break-even analysis for product prices and yields. The break-even values can be calculated from both variable and total costs.

In preparing a break-even budget the values of all the variables except a selected variable are known. For example, a farmer might be interested in substituting one variety of tomato for another, although the production potential of the new variety is unknown. In this situation, the break-even budget is constructed to estimate the minimum yield that would have to be achieved to make the change worthwhile. Alternatively, if the expected yield is known but the price is unknown, the budget could indicate the minimum price that must be obtained to make the change economically feasible.

## PARTIAL BUDGETING

Partial budgeting is a planning tool used by farmers to estimate the effect of on-farm profit of a particular change to an enterprise or activity within the farm. It looks only at those income and decision and expenses that are affected by a proposed change. This is different from a Total budget that looks at the economic and non economic benefits and costs of proposed changes. Many of the day to day decisions made by farmers are really an adjustment of an existing farm plan.

Partial budgeting can be useful when there are proposed changes to a farm such as expansion, introducing a new enterprise, purchasing machinery or equipment or even down-sizing of the farm. These adjustment decisions often affect income and expenses. Thus, partial budgeting is a valuable instrument that shows the effect of marginal changes on overall profitability and in particular, choosing between technologies and enterprises. It is a form of marginal analysis designed to show the net increase or decrease in net farm income resulting from the changes rather than to show the profit or loss for the farm as a whole.

***Four (4) Basic items to be considered in Partial Budgeting***

| *Cost (-)* | *Income (++* |
|---|---|
| a) Additional Costs | c) Additional Income |
| b) Income Lost | d) Costs Saved |
| | |

The Partial budget evaluated whether or not the proposed change would be more profitable than the current situation. The difference between (a + b) and (c + d) will indicate whether the change is worthwhile and profitable. If (c + d) exceeds (a + b) the change increases farm income, provided that it is technically feasible.

*When to Use Partial Budgets*

Many small reorganization problems involve partial budgeting. These are undertaken when the basic farm plan is not changed and the farmer is concerned with the marginal costs and returns resulting from a small change. In many cases where the farm is already planned, partial budgeting for small adjustments may be all that is required. In practice it is not always, or even feasible, to collect information on all the inputs and outputs for an enterprise or technology. The tool only requires information about those outputs and inputs (i.e both expressed in monetary or value terms) that will actually change as a result of small adjustments to the farm business.

Many changes that do not require a complete re-organization of the farm can frequently be identified. Farmers can employ their resources in more than a single way in a response to changes in prices, market demand and the cropping pattern. Partial budgets are useful to evaluate changes such as:

- Expanding an enterprise.
- Selecting alternative enterprises;
- Selecting different production practices;
- Deciding whether to purchase or hire equipment;
- Making a capital improvement;
- Buying new equipment to replace hand labour or maintaining the older equipment.

Partial budgeting is based on the principle that a small change in the farm will have one or more of the following effects:

- Eliminate or reduce some costs.
- Eliminate or reduce some gross income.
- Cause additional costs to be incurred.
- Cause additional gross income to be received.

Partial budgeting gives an general idea whether the proposed change is better or worse in terms of profitability compared with the actual situation. However, it cannot by itself indicate whether both the "before" and "after" situations are profitable. Gross margins are used to do this.

**Examples**

***To compare two different systems of farming such as:***

- direct seeding vs transplanting.
- hand weeding vs herbicide application.
- Pesticide application vs integrated pest management (IPM)

- manual threshing vs machine threshing.
- winnowing by wind vs winnowing by fan.
- sun drying vs use of mechanical dryer.

***To help determine profitability by varying inputs:***

- working 10 vs 15 labour days on the farm.
- applying 3 bags vs 4 bags of fertilizer.
- applying 2 pints vs 3 pints of weedicides.
- transplanting vs direct seeding in planting.
- use of animal vs hand tractor in land preparation.
- sun drying vs use of mechanical dryer.
- using organic vs synthetic fertilizers.

To choose the plan which gives better results.

- Buying vs renting a farm machine
- Feeding pigs with green feed vs commercial feeds.
- early planting to take advantage of high prices vs seasonal planting.

Information needed in Partial Budgeting:

- Price of both inputs and outputs;
- Costs and return of the old practice/resource/plan;
- Costs and return of the new practice/resource/plan.

***Preparing for Partial Budgeting***

A partial budget is prepared by asking four (4 questions):

i. What extra costs will be incurred?

ii. What existing costs will be avoided?

iii. What existing revenue will be lost?

iv. What extra revenue will be gained?

## PARTIAL BUDGET

| | LOSSES ($) | | | GAIN ($) | |
|---|---|---|---|---|---|
| i) | Extra Costs | _____ | iii) | Cost Avoided | _____ |
| ii) | Revenue Lost | _____ | iv) | Revenue Gained | _____ |
| | Net Gain | _____ | | Net Loss | _____ |

If the budget shows a net gain then this is the improvement in profit compared with the existing profit. It is not the overall profit of the enterprise. Thus a net gain means that it will pay to change to the new proposal budgeted. Similarly, a net loss mean that the business will be worse off if the new proposal is adopted.

If the partial budget is for a change requiring additional equipment to show the annual effect on profit, it would be necessary to include an annual charge for depreciation but NOT include the capital outlay in the new equipment within the budget.

**EXAMPLE**

A root crop producer substitutes 1.0ha of Cassava for 1.0ha of Dalo. Extra cost are $20, additional revenue is $2000, costs avoided are $270 and revenue lost is $2800.

| | LOSSES ($) | | | GAIN ($) | |
|---|---|---|---|---|---|
| i) | Extra Costs | $20 | iii) | Cost Avoided | $270 |
| ii) | Revenue Lost | $2800 | iv) | Revenue Gained | $2000 |
| | ***Net Gain*** | ***$2820*** | | ***Net Loss*** | ***$2820*** |

Decision adopt the proposed change.

An important requirement for the preparation of the partial budget is the collection of technical data on the particular aspect of Agriculture which is to be examined in the budget. This means the person preparing the budget needs to have a sound knowledge of the technical aspects of Agriculture relating to the partial change in the farm business. If the farmer keeps good farm records, this can help in obtaining the technical information which is required for the partial budgeting exercise.

As well as measuring changes in profitability, partial budget can also be prepared to measure changes in cash flow relating from a partial change in the farm plan. In this case, it is usually called a Partial Cash Flow Budget.

*(Source : Farm Planning and Management for Trainers of Extension Workers, FAO)*

# LOAN APPRAISAL





Farmers are often interested in assessing their capacity to repay the loans they take out. The capacity to repay loans is assessed by looking at its affect on the farmer's cash flow. The appraisal builds on the net cash flow projection before financing.

In the table below, the annual net cash flow is presented horizontally. The vertical column explains in detail the net financing costs, the net cash flow after financing and the cumulative net cash flow. The methodology of appraising the capacity of the farmer to pay back the loan is also different following the accounting convention that loans are assumed to be received at the end of the year, and the debt service repayment is made in the consecutive year.

Table 6B.1

| Item | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 |
|---|---|---|---|---|---|---|---|
| Cash flow before financing ($) | -2600 | 2500 | 2500 | 2500 | 2500 | 3000 | 2000 |
| ***Loans*** | | | | | | | |
| Long term loans | 1000 | | | | | | |
| | | | | | | | |
| ***Outstanding balance*** | | | | | | | |
| Long term loans | 1000 | 800 | 600 | 400 | 200 | 0 | 0 |
| | | | | | | | |
| ***Repayment of Principal*** | | | | | | | |
| Long term loan | | 200 | 200 | 200 | 200 | 200 | 0 |
| | | | | | | | |
| ***Interest Payments*** | | | | | | | |
| Long-term loans | | 100 | 80 | 60 | 40 | 20 | 0 |
| | | | | | | | |
| Total Cost of financing | | 300 | 280 | 260 | 240 | 220 | 0 |
| Net Financing | 1000 | -300 | -280 | -260 | -240 | -220 | 0 |
| Net Cash Flow after Financing | -1600 | 2200 | 2220 | 2240 | 2260 | 2780 | 2000 |
| Cumulative Cash Flow | -1600 | 600 | 2820 | 5060 | 7320 | 10,100 | 12,100 |

## Computing Loan Repayment

The farmer takes out a loan for $100 at 10 percent interest and a repayment period of 5 years. The calculations involved in appraising the capacity of the farmer to repay the loan are described as follows: The farmer receives a $1000 loan at an interest rate of 10%. Thus the interest paid in Year 2 is $100. The principal on the loan has to be repaid at equal installments over a 5 year period of $200 annually.

The interest payment for 3 years is calculated on the outstanding balance of the loan after

the principal has been repaid. We assume that the loan repayment is made at the end of the year, so interest is due on the full amount of the principal outstanding at the end of the previous year. In year 3, the outstanding balance is the $1000 loan minus $200 repaid as the first installment of the principal (i.e. $800)/

The interest on $800 is $80 ($800 x 10 percent). This is entered as repayment on interest in Year 3. It is assumed that the principle repayment is made at the end of the year, and interest must be paid for a full year on the amount outstanding at the end of the previous year.

Beginning Year 6 the outstanding balance at the end of the previous year has been reduced by the principal repayment of $200 made at the end of Year 5, so the interest is calculated on the outstanding balance of $200 and amounts to $20.

In this particular example, the cumulative cash flow is positive for every year of the investment starting from Year 2. This suggests that the farmer has a liquidity problem in Year 1 but in Year 2 is able to finance the costs of the loan. If the cumulative net cash flow shows a financial shortfall (i.e a negative figure), in any year, the implication is that the farmer would need to find additional financing to cover that shortfall.

# DISCOUNTED METHODS OF INVESTMENT APPRAISAL





## Discounted Methods of Investment Appraisal

Two simple methods of investment appraisal are:

i. Net Present Value (NPV)

ii. Internal Rate of Return (IRR)

Since investment options can be quite complicated, extension workers need to guide farmers in selecting the appropriate method and making the right decisions. But before looking at these methods it is important to understand the time value of money

## The Time Value of Money in Investment Appraisal

Time value of money means that the dollar today does not have the same value a year from now. Understanding the time value of money is important in appraising and making farm investment decisions.

If you were offered $1000 today or $1000 a year from now, which would you choose? There are many reasons for choosing cash now instead of later. One might place the $1000 in a savings account and earn 5 percent interest. This would generate $50 in extra income, an advantage that would be missed by receiving the $1000 one year later.

Other uses could earn the farmer even more money. For example,why wait a year for new farm machinery when it can be purchased and used now? Alternatively, one may worry about the uncertainties of life. Either the giver or the receiver of the $1000 might not be alive in a year to fulfill their part of the transaction. These different reasons demonstrate the importance of the time value of money.

Realizing that money is worth more to a person in the present rather than in the future may appear obvious but quantifying the effect is money complex. Interest rates are used to compare present and future claims on investments .Different interest rates imply different time value.

Lenders of capital receive interest, and borrowers pay interest because of the perceived benefits of time. For example, a lender who provides $100 today at 8 percent interest per year is paid back $108 in 1 year. The $8 compensates the lender for alternative investments not made, personal consumption foregone or the risk that the money might not be repaid.

The borrower and lender agree that $100 today is worth $108 a year from now. The borrower agrees to receive $100 now and pay back $108 in 1 year; the lender gives $100 now to receive$108 in 1 year. However, the lender is not convinced that $8 (8 percent) is enough. It might be that 9 percent interest would be necessary to convince the lender. In this case, the time value of money over the 1-year period would be $9.

Compounding and discounting. The time dimension of money is taken into account through the use of discounting. It is simply a technique by which future benefits and costs can be reduced to a present value. This can be better understood by explaining the notion of compounding.

Example

## Compounding

***Compounding is the process of finding the future value of a present amount.***

Consider a case where a farmer lends $1000 to a neighbor at an interest rate of 5percent annually. The following year the neighbor will owe $1050, consisting of the $1000 principal and $50 in interest($1000 x 0.05).Suppose the neighbor wants to keep the money for two years. Then 5 percent must be paid for the use of money for the first year and an additional 5 percent for the second year. The neighbor must also pay interest on the amount due to have been paid the lender at the end of the first year. In other words, the farmer must be paid compound interest.

Example

## Discounting

***Discounting is the process of finding the present value of a future amount.***

Now suppose we ask a different question. If a borrower promises to pay the farmer $1200 at the end of five years at an interest rate of 8 percent. How much is that promise worth to the farmer today? Put another way, is the present worth of $1200 five years in the future if the interest is assumed to be 8 percent? To answer the question the farmer would have to divide the amount due by 1.08 for each project year as shown below:

**Table 6C.1**

| *Year* | *Amount at the end of the Year ($)* | *One plus interest Rate* | *Amount at the beginning of the Year ($)* |
|---|---|---|---|
| 1 | 1,200 | 1.08 | 1,111 |
| 2 | 1,111 | 1.08 | 1,029 |
| 3 | 1,029 | 1.08 | 953 |
| 4 | 953 | 1.08 | 882 |
| 5 | 882 | 1.08 | 817 |

The present value of $1,200, 5 years in the future, is $817.00.

This process of finding the present worth of a future value is called 'discounting'. Discounting looks backward from the future to the present. The interest rate assumed for discounting is the 'discount rate' (see Table 5C.2). Using this table the discount factor for 8 percent and 5 years is given as 0.681. To find the present value of $1200 received 5 years in the future, the amount due in the future is multiplied by the discount factor for the fifth year. This gives $817 (1,200 x 0.681 = 817).

Example

***Find the present value of $6,438 received 9 years in the future if the discount rate is 15 percent.***

The relevant factor in the discounting tables shows that at a 15 percent rate and for a period of 9 years, the co-efficient is 0.284. The future amount is multiplied by the discount factor

to obtain a present value of $1828 ($6,438 x 0.284 = $1,828)

## NET PRESENT VALUE (NPV)

The NPV of an investment is the sum of the present values for each year's net cash flow less the initial cost of the investment. It is also called the discounted cash flow method because it uses the discounting method of analysis. This method considers the time value of money and the stream of cash flows over the entire life of the investment.

A general rule regarding the number of years to include in the cash flow analysis is to choose a period of time that is comparable to the life of the major investment item. In the case of farm machinery and equipment, this is often taken as between 5 and 7 years and for buildings 30 to 40 years.

With this method, the farmer would accept an investment with a positive NPV, reject those with a negative NPV and be indifferent to a zero value. The rationale behind accepting investments with a positive NPV can be explained in two (2) ways.

First, it means the rate of return on the investment is greater than the discount rate used in the calculations. A second explanation is that the farmer can afford to pay more for the investment and still achieve a rate of return equal to the discount rate used in calculating the NPV.

### EXAMPLE

**Calculating net present value.**

This example assumes that the investment has no salvage value at the end of its life. If this assumption is relaxed, an entry would need to be made of the salvage value of the investment as part of the cash inflow and entered in the respective year incurred.

**Table 6C.2**

| Year | Investment A | | | Investment A | | |
|---|---|---|---|---|---|---|
| | Net Cash Flow ($) | Discount Rate | Present Value ($) | Net Cash Flow ($) | Discount Rate | Present Value ($) |
| 1 | 3000 | 0.926 | $2,778 | 1000 | 0.926 | $926 |
| 2 | 3000 | 0.857 | $2,571 | 2000 | 0.857 | $1,714 |
| 3 | 3000 | 0.794 | $2,382 | 3000 | 0.794 | $2,382 |
| 4 | 3000 | 0.735 | $2,205 | 4000 | 0.735 | $2,940 |
| 5 | 3000 | 0.681 | $2,043 | 6000 | 0.681 | $4,086 |
| | | **Total** | **$11,979** | | | **$12,048** |
| | | Less Investment Costs | $10,000 | | | $10,000 |
| | | Net Present Value | $1,979 | | | $2,048 |

The farmer could pay up to $11,979 ($10,000 + $1979) for investment A and $12,048 ($10,000 + $2,048) for investment B and still receive an 8 percent return or more on invested capital. Both investments show a positive NPV using an 8 percent discount rate.

The selection of the discount rate consequently affects the result of the appraisal. When a higher discount rate is used, the NPV decreases and vice versa. At some higher discount rates the NPV values would be zero, and at an even higher rate it could become negative.

### INTERNAL RATE OF RETURN

The IRR is the interest rate at which the NPV of an investment is equal to zero. This is the maximum rate of interest that the farmer can afford to pay for the resources used, in order to recover the original investment and its operating costs and still break even.

**Calculating the Internal Rate of Return**

Since there is no formula for finding IRR, a procedure of trial and error is needed in an attempt to equate the net present value of the cash flow with the zero breakeven point.

**Table 6C.3**

| Year | Net Cash Flow ($) | 14% | | 16% | |
|---|---|---|---|---|---|
| | | Present Value Factor | Present Value ($) | Present Value Factor | Present Value ($) |
| 1 | 3000 | 0.877 | $2,631 | 0.862 | $2,586 |
| 2 | 3000 | 0.769 | $2,307 | 0.743 | $2,229 |
| 3 | 3000 | 0.675 | $2,025 | 0.641 | $1,923 |
| 4 | 3000 | 0.592 | $1,776 | 0.552 | $1,656 |
| 5 | 3000 | 0.519 | $1,557 | 0.476 | $1,428 |
| | | Total | $10,296 | | $9,822 |
| | | Less Investment Cost | $10,000 | | $10,000 |
| | | | **$296** | | **-$178** |

The relatively high NPV of the investment with an 8 percent discount rate suggests that the actual rate of return on the investment may be considerably higher than this rate. An interest rate of 14 percent was arbitrarily chosen as a first estimate of the IRR. The calculation shows a positive NPV of $296, indicating that the IRR is still high and in excess of zero, the break-even point. An even higher discount rate is used next (16%) assuming that this will result in a lower NPV. The result shows that there is a negative IRR of -$178. The actual IRR lies somewhere between 14 and 16%.

The most difficult aspect of this trial an error process is making an initial estimate. If the estimate is too far from the final result, then several trials will have to be made to find two (2) rates that are close enough to allow the breakeven point to be calculated. This is done by interpolation (i.e finding a desired value between two (2) other values).

The rule for interpolating the value of IRR between two (2) discount rates (with a negative and positive NPV) is as follows:

$$\text{Low Discount rate} + \frac{\text{High NPV}}{\text{High NPV - Low NPV}} \times (\text{High discount rate - Lower Discount Rate})\%$$

This procedure is applied to the above example. The lower discount rate is 14%. The difference between the 2 rate is 2%. The present worth of the lower discount rate cash flow is $296 and the present worth of the higher rate is -$178. The sum of the present worth of the cash flows at the two (2) discount rates, ignoring the signs is $474.

Through interpolation the IRR is calculated as follows:

$$14\% + \frac{296}{296 - (-178)} \times (16 - 14) = 15.2\%$$

At a discount rate of 15.2% the investment just breaks even. From another angle the IRR can be understood as the earning capacity of the investment.

The formal selection decision for the IRR is to accept all investments with a return equal to or greater than the discount rate. If the IRR of the investment as a whole is lower than the discount rate, the investment is not profitable. If the IRR exceeds the interest rate, the farmer may try to borrow as much as possible to increase the return on investment.

Finally, it should be pointed out that an IRR can only be calculated when at least one value in the net cash flow is negative. if all the values are positive, no discount rate can make the NPV of the cash flow equal to zero. In this even the IRR would be infinite.

**Selection of Discount Rate**

An appropriate discount rate has to be selected in order to use discounted measures of investment appraisal. The discount rate used is usually the cost of capital to the farmer for whom the appraisal is being done. But how should the cost of capital be measured? This is often assumed to be the rate of interest at which the farmer is able to borrow money. However, if the capital that the farmer uses to finance the investment is a mixture of equity and borrowed capital, the discount rate should also be weighted to take account of the return necessary to attract equity capital on the one hand and the borrowing rate on the other.

A weighted average cost of capital (WACC) calculation is needed, estimating the rate of return for both forms of capital tied up in the investment: debt and equity. This reflects the cost of all forms of financing that the farmer may use.

The WACC can be calculated as follows:

**WACC = Equity Capital x Return needed to Attract Equity Capital + Borrowed Capital x Borrowing Rate**

**Total Capital** **Total Capital**

The proper set of weights to use is the relative proportion of each type of capital in the farmer's desired financing of the investment. The assumption is that the farmer will, fund the capital investment in the proportions assumed in the weighting system. If bank loans represent 67% of a farmer's fund, it should be assigned a weight of 0.67. If equity capital represents 33% of the investment, it would be given a weight of 0.33.

While the interest rate charged on long term bank loans is used as the cost of capital from lending, placing a meaningful cost on equity capital is much more difficult. This is so because equity has no clear cost. There is no interest paid. However, there is an opportunity cost. If farmer's put their money into an investment they are denied the use of these funds for other purposes. If by investing in their own farms, the farmers forgo making investments that will earn 10%, they should view equity capital as costing the alternative 10%.

The opportunity cost of farmer's equity differs between farmers because individuals differ in their abilities to find alternative investment possibilities for their capital and in their management capacity and attitude to risk. With this in mind farmers must use their judgement in assessing their cost of equity. The important point is for the farmer to recognize that equity capital is not "costless" and in fact, should be regarded as a more

expensive source of capital than bank loans.

Example

Calculating Weighted Average Cost of Capital

In this example, the WACC is 8%. Investments

**Table 6C.4**

| Source | Amount | Weighted Cost of Capital |
|---|---|---|
| Loan (7% IR) | 5000 (67%) | 7% of 67% = 4.7% |
| Equity Capital (10% IR) | 2500 (33%) | 10% of 33% = 3.3% |
| Total | $7500 (100%) | Total = 0.8% |

promising a return of less than 8 percent (i.e investments with a negative NPV using 8% as the discount factor or investments with an IRR of less than 10%) would appear undesirable. On the other hand, investments promising a rate of return of something over 8% would be acceptable.

## COMPARISON OF MEASURES

The two (2) discounting measures give the same answer to the simple question of whether the investment pays. Many extension workers might prefer the NPV criterion for its simplicity, unambiguous quality and straight forward way of selecting among mutually exclusive investments. Some, however, may prefer the IRR criterion because it is understood easily by those unfamiliar with the discounted measures. The IRR can be explained easily as the maximum rate of interest that a farmer could pay if all resourced used in the investment were borrowed.

But if the investment alternatives considered by the farmer are mutually exclusive, the IRR is not a useful measure and the NPV would be more appropriate. The NPV better serves this purposes because it measures the absolute surplus of the benefits over the costs, discounted. Furthermore, it escapes the problem of having to estimate the opportunity cost of capital to the farmer.

## Table 6C.5

*Rate of Interest (%)*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.990 | 0.980 | 0.971 | 0.962 | 0.952 | 0.943 | 0.935 | 0.926 | 0.917 | 0.909 | 0.901 | 0.893 | 0.885 | 0.877 | 0.870 | 0.862 | 0.855 | 0.847 | 0.840 | 0.833 |
| 2 | 0.980 | 0.961 | 0.943 | 0.925 | 0.907 | 0.890 | 0.873 | 0.857 | 0.842 | 0.826 | 0.812 | 0.797 | 0.783 | 0.769 | 0.756 | 0.743 | 0.731 | 0.718 | 0.706 | 0.694 |
| 3 | 0.971 | 0.942 | 0.915 | 0.889 | 0.864 | 0.840 | 0.816 | 0.794 | 0.772 | 0.751 | 0.731 | 0.712 | 0.693 | 0.675 | 0.658 | 0.641 | 0.624 | 0.609 | 0.593 | 0.579 |
| 4 | 0.961 | 0.924 | 0.888 | 0.855 | 0.823 | 0.792 | 0.763 | 0.735 | 0.708 | 0.683 | 0.659 | 0.636 | 0.613 | 0.592 | 0.572 | 0.552 | 0.534 | 0.516 | 0.499 | 0.482 |
| 5 | 0.951 | 0.906 | 0.863 | 0.822 | 0.784 | 0.747 | 0.713 | 0.681 | 0.650 | 0.621 | 0.593 | 0.567 | 0.543 | 0.519 | 0.497 | 0.476 | 0.456 | 0.437 | 0.419 | 0.402 |
| 6 | 0.942 | 0.888 | 0.837 | 0.790 | 0.746 | 0.705 | 0.666 | 0.630 | 0.596 | 0.564 | 0.535 | 0.507 | 0.480 | 0.456 | 0.432 | 0.410 | 0.390 | 0.370 | 0.352 | 0.335 |
| 7 | 0.933 | 0.871 | 0.813 | 0.760 | 0.711 | 0.665 | 0.623 | 0.583 | 0.547 | 0.513 | 0.482 | 0.452 | 0.425 | 0.400 | 0.376 | 0.354 | 0.333 | 0.314 | 0.296 | 0.279 |
| 8 | 0.923 | 0.853 | 0.789 | 0.731 | 0.677 | 0.627 | 0.582 | 0.540 | 0.502 | 0.467 | 0.434 | 0.404 | 0.376 | 0.351 | 0.327 | 0.305 | 0.285 | 0.266 | 0.249 | 0.233 |
| 9 | 0.914 | 0.837 | 0.766 | 0.703 | 0.645 | 0.592 | 0.544 | 0.500 | 0.460 | 0.424 | 0.391 | 0.361 | 0.333 | 0.308 | 0.284 | 0.263 | 0.243 | 0.225 | 0.209 | 0.194 |
| 10 | 0.905 | 0.820 | 0.744 | 0.676 | 0.614 | 0.558 | 0.508 | 0.463 | 0.422 | 0.386 | 0.352 | 0.322 | 0.295 | 0.270 | 0.247 | 0.227 | 0.208 | 0.191 | 0.176 | 0.162 |
| 11 | 0.896 | 0.804 | 0.722 | 0.650 | 0.585 | 0.527 | 0.475 | 0.429 | 0.388 | 0.350 | 0.317 | 0.287 | 0.261 | 0.237 | 0.215 | 0.195 | 0.178 | 0.162 | 0.148 | 0.135 |
| 12 | 0.887 | 0.788 | 0.701 | 0.625 | 0.557 | 0.497 | 0.444 | 0.397 | 0.356 | 0.319 | 0.286 | 0.257 | 0.231 | 0.208 | 0.187 | 0.168 | 0.152 | 0.137 | 0.124 | 0.112 |
| 13 | 0.879 | 0.773 | 0.681 | 0.601 | 0.530 | 0.469 | 0.415 | 0.368 | 0.326 | 0.290 | 0.258 | 0.229 | 0.204 | 0.182 | 0.163 | 0.145 | 0.130 | 0.116 | 0.104 | 0.093 |
| 14 | 0.870 | 0.758 | 0.661 | 0.577 | 0.505 | 0.442 | 0.388 | 0.340 | 0.299 | 0.263 | 0.232 | 0.205 | 0.181 | 0.160 | 0.141 | 0.125 | 0.111 | 0.099 | 0.088 | 0.078 |
| 15 | 0.861 | 0.743 | 0.642 | 0.555 | 0.481 | 0.417 | 0.362 | 0.315 | 0.275 | 0.239 | 0.209 | 0.183 | 0.160 | 0.140 | 0.123 | 0.108 | 0.095 | 0.084 | 0.074 | 0.065 |
| 16 | 0.853 | 0.728 | 0.623 | 0.534 | 0.458 | 0.394 | 0.339 | 0.292 | 0.252 | 0.218 | 0.188 | 0.163 | 0.141 | 0.123 | 0.107 | 0.093 | 0.081 | 0.071 | 0.062 | 0.054 |
| 17 | 0.844 | 0.714 | 0.605 | 0.513 | 0.436 | 0.371 | 0.317 | 0.270 | 0.231 | 0.198 | 0.170 | 0.146 | 0.125 | 0.108 | 0.093 | 0.080 | 0.069 | 0.060 | 0.052 | 0.045 |
| 18 | 0.836 | 0.700 | 0.587 | 0.494 | 0.416 | 0.350 | 0.296 | 0.250 | 0.212 | 0.180 | 0.153 | 0.130 | 0.111 | 0.095 | 0.081 | 0.069 | 0.059 | 0.051 | 0.044 | 0.038 |
| 19 | 0.828 | 0.686 | 0.570 | 0.475 | 0.396 | 0.331 | 0.277 | 0.232 | 0.194 | 0.164 | 0.138 | 0.116 | 0.098 | 0.083 | 0.070 | 0.060 | 0.051 | 0.043 | 0.037 | 0.031 |
| 20 | 0.820 | 0.673 | 0.554 | 0.456 | 0.377 | 0.312 | 0.258 | 0.215 | 0.178 | 0.149 | 0.124 | 0.104 | 0.087 | 0.073 | 0.061 | 0.051 | 0.043 | 0.037 | 0.031 | 0.026 |
| 21 | 0.811 | 0.660 | 0.538 | 0.439 | 0.359 | 0.294 | 0.242 | 0.199 | 0.164 | 0.135 | 0.112 | 0.093 | 0.077 | 0.064 | 0.053 | 0.044 | 0.037 | 0.031 | 0.026 | 0.022 |
| 22 | 0.803 | 0.647 | 0.522 | 0.422 | 0.342 | 0.278 | 0.226 | 0.184 | 0.150 | 0.123 | 0.101 | 0.083 | 0.068 | 0.056 | 0.046 | 0.038 | 0.032 | 0.026 | 0.022 | 0.018 |
| 23 | 0.795 | 0.634 | 0.507 | 0.406 | 0.326 | 0.262 | 0.211 | 0.170 | 0.138 | 0.112 | 0.091 | 0.074 | 0.060 | 0.049 | 0.040 | 0.033 | 0.027 | 0.022 | 0.018 | 0.015 |
| 24 | 0.788 | 0.622 | 0.492 | 0.3900 | 0.310 | 0.247 | 0.197 | 0.158 | 0.126 | 0.102 | 0.082 | 0.066 | 0.053 | 0.043 | 0.035 | 0.028 | 0.023 | 0.019 | 0.015 | 0.013 |
| 25 | 0.780 | 0.610 | 0.478 | 0.375 | 0.295 | 0.233 | 0.184 | 0.146 | 0.116 | 0.092 | 0.074 | 0.059 | 0.047 | 0.038 | 0.030 | 0.024 | 0.020 | 0.016 | 0.013 | 0.010 |
| 26 | 0.772 | 0.598 | 0.464 | 0.361 | 0.281 | 0.220 | 0.172 | 0.135 | 0.106 | 0.084 | 0.066 | 0.053 | 0.042 | 0.033 | 0.026 | 0.021 | 0.017 | 0.014 | 0.011 | 0.009 |
| 27 | 0.764 | 0.586 | 0.450 | 0.347 | 0.268 | 0.207 | 0.161 | 0.125 | 0.098 | 0.076 | 0.060 | 0.047 | 0.037 | 0.029 | 0.023 | 0.018 | 0.014 | 0.011 | 0.009 | 0.007 |
| 28 | 0.757 | 0.574 | 0.437 | 0.333 | 0.255 | 0.196 | 0.150 | 0.116 | 0.090 | 0.069 | 0.054 | 0.042 | 0.033 | 0.026 | 0.020 | 0.016 | 0.012 | 0.010 | 0.008 | 0.006 |
| 29 | 0.749 | 0.563 | 0.424 | 0.3210 | 0.243 | 0.185 | 0.141 | 0.107 | 0.082 | 0.063 | 0.048 | 0.037 | 0.029 | 0.022 | 0.017 | 0.014 | 0.011 | 0.008 | 0.006 | 0.005 |

1) To find present value (PV) of future amount : PV = Facto x Amount

2) To find future amount representing the present value: Amount = PV /Factor

***(Source : Farm Planning & Management for Trainers of Extension Workers, FAO)***

APPENDIX 7A

# LAND ACTS

(Registration, Valuation, Landuse, Tenure & Acts)

- LAND REGISTRATION
- LAND TRANSFER ACT, PROPERTY LAW ACT
- VALUATION OF LAND
- AGRICULTURAL LANDLORD AND TENANT ACT
- LAND USE CLASSIFICATIONS
- LAND TENURE
- CROWN LEASES
- FIJIAN AND TENURE
- NATIVE LAND TRUST BOARD AND LEASE
    - Native Land Trust Act (Chapter 134)
    - Conditions of Agricultural lease
    - Condition of Grazing lease
    - Application of lease native land

## LAND REGISTRATION

This explanation covers the general aspects of land registration under the "Torrens Systems". Sir Robert Torrens was the originator of this particular system and the "Land Transfer and Registration of Titles" Act of Fiji is based on his system.

A block of land is given a name or number and is entered in a register. A description of the land i.e boundaries, area etc, is also entered as is the name of the owner. The owner is known as the registered is proof of his ownership. This is known as "registration of title"; title means ownership. The registration of the boundaries and area is known as "registration of parcels".

This description is based on a survey of the land and a plan of this survey is also registered for reference purposes. It is the usual practice for the state or crown (Government) to guarantee both parcels and titles. That is they guarantee that the name appearing on the register is that of the lawful owner and that the boundaries of the land are correct as they were originally surveyed and registered. For this reason all plans affecting registered land are subject to examination by government officers. In Fiji, this examination is carried out on behalf of the Registrar of Titles by the staff of the Lands Department. All transactions affecting a piece or block of registered land must be registered before they are legal. In Fiji these transactions are called "Dealings".

If a man sells his land the sale is registered and the new owners name is placed on the register. If he leases the land the particulars of the lease are registered as is the lessee's name. If the owner wishes to sell only part of the land it is necessary for him to have a survey made of the new boundaries and register or deposit a plan of the survey. The piece of land sold is registered separately. If the registered proprietor wishes to allow another man to use part of his land for some special purpose, without in any way affecting the ownership of that piece he may grant an "easement".

Common types of easements are access easements (right-of-way) and drainage easements. By granting a man an access easement he allows that man to pass freely, by a certain route, over is land. Particulars of all such easements must be registered. If the owner wishes to borrow money and pledge his land as security he is said to mortgage his land. The particulars of the mortgage are registered and when the money has been repaid, or the mortgage discharged, this discharge is register. There are other dealings which must be registered but those mentioned are the main ones affecting surveyors.

**FORM OF THE REGISTER**

The main part of the register consists of bound copies of certificates of titles. As ell as this there are bound volumes of dealing or transactions, a register of names of owners and a day book in which are noted all dealings when they are presented for registration. All these separate parts of the register are cross referenced so that using the owners name as a guide it is possible to look up all transactions and affecting the land are also referenced to it. The certificate of title is the main document on which land registration matters are noted. On the certificate of title (C.T.) is a plan of the land together with a description of the boundaries based on the survey plan, the number of which is noted.

All transactions are then noted in chronological order but the particulars of them are given in the dealings only and a reference number is given for the dealing. The certificate of title is usually duplicated. The original is kept by the registrar and the "outstanding copy' by the registered proprietor. Whenever a transaction takes place the outstanding copy must be presented to the registrar so that the transaction may be noted on it. These two certificates should always be identical.

The main purpose of registration of land is to protect the owner and other interested parties (lessees, holders of easements etc) against unlawful claims to their land or interests in the land. When a man is registered as the proprietor he holds an "indefeasible" title to the land i.e his ownership cannot be disputed. In the same way his boundaries as surveyed and registered cannot be disputed.

To attain this the Registrar of Titles must be absolutely certain that all survey plans and documents presented for registration are correct in all respects and he can require people presenting documents etc to prove the reliability of the documents. For this reason all survey affecting registered land must be done in accordance with survey affecting registered land must be done in accordance with survey regulations and attain prescribed standards of accuracy. As mentioned earlier all these plans must be examined and approved before they are finally registered.

**LAND TRANSFER ACT, 1971**

The Act is designed to provide for law relating to transfer of land and the registration of title of land. It is based on the 'mirror principle' and provides for damages to any person who sustains loss because of misfeasance or mistake of registrar.

The provisions relate closely to those of the Torrens System of Land Titles and of fundamental importance is the provision which makes every new title an indefeasible title completed in itself completed in itself.

The Registrar of Titles and his deputies are given wide powers to implement the provisions of the Act and appeal lies with the supreme court. New Crown Grants and acquisition of land from all crown grants are originated by the director of land who is also responsible for the issue of all transfers of Native Land to the Crown.

The Act provides fort eh recording of all crown and native grants and their subsequent transfers and fragmentation, also registration of leases thereof and of new crown and native leases. Native Leases originate from the Native Land Trust Board.

**Property Law Act**

This is a complementary Act to the Land Transfer Act and deals with rights and remedies of parties relating to real or personal properties and also unregistered dealings in land.

**Valuation of Land**

Until the late 1940's, valuations and revaluations of Towns and Townships for rating purposes as well as valuations for death and gift duty purposes were undertaken by the Lands, Mines and Surveys Department. It was only when the strength of the Valuation section of the department become inadequate that the employing of private valuers was adopted. The strength of the valuation section improved during 1960. The Valuation section staff were then capable of dealing with valuations and revaluations for township ratings and for death and gift duties. It now carries out all the valuations required by the government of Fiji.

The modern concept of valuation practiced in other parts of the worlds relies on the central government valuation agency for a variety of purposes. In particular equitable and uniform land values are required in connection with the following:-

The levying of Land Tax;
The appointment of Hospital Boards, DRAINAGE Board's and other similar rating levies over contributory local authorities;
The levying of rates by Local Authorities;
The advancing of money on mortgage by government departments and by trustee under Trustee legislation;
The assessing of stamp, death and gift duties;
The fixing of Crown rentals;
The assessing compensation payable where land is acquired by government and local authorities;
In estimating the prices payable for land generally;
In assessing rentals under Fair Rents Acts.

In Fiji many of the above items are covered by separate acts each of which requires the appointment of a valuer. In actual practice, as it was found in other countries, Fiji now frequently finds a multiplicity of purpose of the valuation and on the valuer who did the assessment. To overcome this undesirable state of affairs and in an attempt to stabilize values, most countries have seen the necessity of establishing a department of state charged with the duty of assessing the values of real estate for taxation and other purposes for government, and for local rating purposes. Fiji is following this trend in that a valuation section ahs been established within the ministry of lands, local government and housing.

The advantages of such an arrangement are very obvious particularly from an economic view point. The value of any property is immediately available for whatever purposes it is required and the process of keeping values uniform and stable is simplified. The system also conforms to a basic principle in valuation is being made cannot and should not in itself affect the value ascertained. The value to be found is the market value and there cannot be two market values of the property at the same time.

**AGRICULTURAL LANDLORD AND TENANT ACT**

Reference: 1967 Laws of Fiji – Chapter 270

" An Act to provide fort he relations between landlords and tenant of agricultural holding and for matters connected therewith".

The extracts in this section outline briefly the main issues contained in the Act and have been presented to help the reader in his understanding of the Act. For further reading, one is advised to consult the reference Law Book noted above.

**Application**

The Act shall apply to all agricultural land in Fiji except:-
Holding less than 2 and a half acres
Tenancies held by members of a registered co-operative society where the society is the landlord
All native land situated within a native reserve.

**Security of Tenure**

4 (i) Where a person is in occupation of and in cultivating an agricultural holding and such occupation and cultivation has continued before or after the commencement of this Act for a period of not less than 3 yrs and the Landlord has taken no steps to evict him, the onus of proof, a tenancy shall be presumed to exist under the provisions of this Act; Provide that any such steps taken between the 20th day of June 1966 and the commencement of this Act shall be no bar to the operation of this subsection. Where payment in money or kind to a landlord by a person occupying any of the land of such landlord is proved, such payment shall, in the absence of proof to the contrary, be presumed to be rent.

5 (i) A person who maintains that he is a tenant and whose landlord refused to accept him as such may apply to a tribunal for a declaration that he is a tenant and if the tribunal makes such a declaration, the tenancy shall be deemed to have commenced when the tenant first occupied the land: Provided that rent shall only be recovered where the tribunal is satisfied that is just and reasonable so to order.

Where an agricultural holding is held by a Fijian according to native custom, he or a person authorized in writing by the NLTB may apply to a tribunal for a declaration that a tenancy under the provisions of this Act exists and from a date specified in such declaration, which shall not have retrospective effect, the provisions of this act shall apply to such holding and such rent as my be assessed and fixed by the tribunal in respect thereof shall be paid to the NLTB.

Valuation, to a large degree, is based on a sound statistical system and the keeping of complete and up-to-date records. A government department has every advantage over the individual in this regard since the maintenance of the information required (such as plans and surveys information, and records of sales and transactions) is a normal duty of government departments.

Major Acts dealing with valuation of Lands in Fiji are:-
Local government act and regulations made thereunder
Fijian Affairs subsidiary legislation
Estate and Gift Duties Act
Agricultural Landlord and Tenant Act
Crown Lands Act and Regulations
Native Land Trust Act and Regulations made there under
Crown Acquisition of Lands Act
Fiji Meats Industry Act
The basis for valuation is defined in the Local Government Act as well as the Fijian Affairs Subsidiary Legislation. An extract from the form reads as follows:-

**LOCAL GOVERNMENT ACT 1972 PART X RATING – VALUATION**

For the purpose of ascertainment of unimproved value under the provisions of this act "unimproved value' means the capital sum which the land, if it were held for an estate in fee simple unencumbered by any mortgage or charge thereon, might be expect to realize at the time of valuation or revaluation if offered for sale on such reasonable terms and conditions as a bona fide seller might be expected to require and assuming that the improvements, if any, thereon or appertaining thereto has not been made:

Provided that in any valuation of land on which structures have been erected such valuation shall take into account the actual use of land and not the use for which the land is zoned under any existing scheme.

64(i) For the purpose of ascertaining and determining the unimproved value of rateable land, every council shall cause a valuation hereinafter called a general valuation, of all such land to be made at least once in every six years.

Unimproved value for assessment and reassessment of rental is defined in the Agricultural Landlord and Tenant Act.

The **Crown Land Act** and **Native Land Trust Act** also provide the basis of rental reassessments.

(a) Any contract of tenancy created after the commencement of this Act but before the date of coming into force of the A.L.T (Amendment) Act 1976, shall be deemed to be a contract of tenancy for a team of not less than 10 years

(b ) Any contract of tenancy created after the date of coming into force of the ALTA (Amendment) Act 1976 shall be deemed to be a contract of tenancy for a term of not less than 30 years.

13 (i) Subject to the provisions of this act relating to the termination of a contract of tenancy, a tenancy, a tenant holding under a contract of tenancy created before or extended pursuant to the provisions of this act in force before the date of coming into force if the Alta (Amended) Act 1976, shall be entitled to be granted a single extension (or a further extension as the case may be) of his contract of tenancy for a period of 20 years unless:-

During the term o such contract the tenant has failed to cultivate the land in a manner consistent with the practice of good husbandry or The contract of tenancy was created before the commencement of this Act and has at the date of the coming into force of the Agricultural Landlord & Tenant (Amendment) Act 1976 an unexpired term of more than 30 years.

**Part III – Agricultural Tribunal & Committee of Valuers**

16 (i) The Minister may, by notification is the Gazette, and in accordance with the provisions of this Act, established as many agricultural tribunals as he thinks fit. A tribunal shall sit in public so often as may be required, at such time and place as the tribunal may determine.

21 (i) There is hereby established the committee of Valuers which shall consist of 4 persons to be appointed by the Minister responsible for land matters.

(ii) The function of the Committee shall be to determine and by order publish in the Gazette, declare the unimproved capital values of the different classes of agricultural land the subject of an agricultural holdings, the first such order to be published within one month of the date of coming into force of the Agricultural Landlord & Tenant (Amendment) Act 1976 and subsequent orders to be published every 5 years thereafter: Provided that the Committee may differentiate in any such order

between types or classes of land and in respect of land situated in different parts of Fiji.

**Part IV – Powers & Duties of Tribunals**

22 (i) In respect of its agricultural district, a tribunal may, upon the application of a landlord or tenant of an agricultural holdings:- Assess, fix and certify the maximum rent to be paid in respect of such holding and specify the date from which such assessment is to have effect;

Determine whether compensation is payable and, if so, the amount thereof in relation to the holding in an case where the tribunal has a power or duty to determine compensation under the provision of this Act;
Grant leave to the landlord to resettle the tenant on other suitable land;
Re-parcel and re-allocate agricultural land……..;
Grant leave to the landlord to reduce the size of the holding;
Authorize and direct the recovery of the holding……..;
Grant relief against eviction, re-entry or forfeiture in respect of any holding whether created ot is existence before or after the commencement of this Act;
Authorize and direct the transfer of subletting of the holding;
In the case of any dispute, specify the area and boundaries of an agricultural holding……;
Decide any dispute between a landlord and tenant of agricultural land……;
Exercise any other power or duty conferred or imposed by or under the provisions of this Act.

22(2) Save where the landlord is the owner of the improvements; or where the agricultural holding is to be let by tender, the tribunal, in assessing fixing and certifying the maximum rent for an agricultural holding, shall allow the landlord a return for an agricultural holding, shall allow the landlord a return of not more than 6% per annum on the unimproved capital value of the land……

22(3) For the purpose of subsection (2),'unimproved capital value" means the capital sum which the land the subject of the agricultural holding, if it were held for an estate in fee simple unencumbered by any mortgage or charge thereon, might be expected to realize at the time the maximum rent was assessed, fixed and certified if offered for sale with vacant possession on such reasonable terms and conditions as a bona fide seller might be expected to require and assuming that nay improvements thereon or appertaining thereto mad by the tenant or acquired by the tenant has nit been made.

Provided that such capital sum shall only take into account the purpose for which the land is leased and not the actual use of the land or nay purpose for which the land could be used.

For the purpose of this subsection, "improvement" include building of all descriptions, fencing, furrows, planting trees o live hedges, walls, wells, draining land or reclamation of swamps, road-making, bridges, tramways, laying out and cultivating gardens and nurseries, water works, sheep or cattle dips, excavation and leveling, embankments or protective works of any kind, fixed machinery, irrigation works, water tanks, planting of long lived crops, and clearing of land for agricultural purposes.

**Compensation for improvements**

40 (i) Where the tenant of an agricultural holding has, after the commencement of this Act, made and caused or permitted to be made thereon any of the improvements specified in the schedule to this act, he shall, subject as is in this act mentioned, whether the improvements specified in the schedule to this Act, he shall, subject as is in this Act mentioned, whether

the improvements was or was not an improvement which was required to make by the terms of his tenancy, be entitled, at the termination of the tenancy, to obtain from the landlord as compensation for the improvement such sum as fairly presents the value of the improvements to an incoming tenant.

Provide…… the consent or notice required…….. has been so obtained or given……

49 (i) Any person aggrieved by an order of the committee made under subsection (2) of section 21 may appeal to the Central Agricultural Tribunal within 3 months of the date of publication of the order.

64 The provisions of this Act shall apply to the Crown and to crown agricultural land.

## GRAZING LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | **MAF LUC EQUIVALENT** |
|---|---|---|---|---|---|
| VITI LEVU | 1st Class Grazing Land very few limitations | Contour: Flat to nearly flat (0-7) degrees<br>Soil: Fertile | $800 | 1 Adult beast to 1-1.5 hectares | I + II |
| | 2nd Class Grazing land Moderate limitations | Contour: Moderate Slopes (8-15) degrees<br>Soil: Reasonably fertile | $500 | 1 Adult beast to 1.5-2.5 hectares | III + IV |
| | 3rd Class Grazing land severe limitations | Contour: Steep slopes (16-20) degrees<br>Soil: poor | $300 | 1 Adult beast to 2.5-3.5 hectares | V |
| | Marginal<br>Very severe limitations | Contour: Very steep and broken (21 degrees +)<br>Soil: Very poor, (talasiga) | $100 | 1 Adult beast to 3.5 hectares and over | VI |

## GRAZING LAND

| | | | | | |
|---|---|---|---|---|---|
| VANUA LEVU | 1st Class Grazing land Very few limitations Contour: Flat to nearly flat (0-7) degrees | Soil: Fertile | $750 | 1 Adult beast to 1-1.5 hectares | I-II |
| | 2nd Class Grazing land severe limitations | Contour: Steep slopes (16-20) degrees Soil: Poor | $450 | 1 Adult beast to 2.5-3.5 hectares | III + IV |
| | 3rd Class Grazing land Severe limitations | Contour: Steep slopes (16-20) degrees Soil: Poor | $200 | 1 Adult beast to 2.5-3.5 hectares | V |
| | Marginal Very severe limitations | Contour: Very steep and broken (21 degrees +) Soil: Very poor, (talasiga) | $75 | 1 Adult beast to 3.5 hectares and over. | VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply. Location needs to be taken into account in determining value.

The Remarks Column represents yields from an average farm under average management and ore.

## DAIRY LANDS

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| a) SOUTH AND SOUTH EAST VITI LEVU<br><br>Provinces:<br>Tailevu<br>Rewa<br>Naitasiri<br>Serua<br><br>Localities:<br>Korovou<br>Sawakasa<br>Rewa<br>Vunidawa<br>Navua<br>Serua | 1st Class Very few limitations | Soil: Fertile, deep well drained and well suited for the establishment of pasture<br>Contour: Flat to nearly flat (0-3) degrees | $2200 | 1 Milking Cow to 0.5 hectare or 100 kg of butter fat per hectare. | I |
| | 2nd Class Moderate limitations | Contour: Flat to gentle slopes (4-11) degrees<br>soil: Reasonably fertile but artificial fertilizer is required for good pasture. Poor natural drainage | $1100 | 1 Milking cow to 0.75 hectare or 75kg of butter fat per hectare | II + III |
| | 3rd Class severe limitations | Contour: Moderate Slopes (12-20) degrees. Swampy flats<br>Soil: poor fertility; peaty. | $450 | 1 Milking cow to 1.25 hectare or 50kg of butter fat per hectare | IV + V |
| | Marginal Very severe limitations | Contour: Steep slopes (21 degrees +)<br>Soil: very poor soil, severe erosion hazards. | $180 | 1 Milking cow to 1.5 hectares or 40kg of butter fat per hectare. | VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

All the above yields are calculated on butter fat production from pasture only.
Location needs to be taken into account in determining the value.
The Remarks column represents yields from an average farm under average management and are guidelines only.

## DAIRY LANDS

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| (b) NORTH, NORTH WEST & SOUTH WEST VITI LEVU<br><br>Provinces:<br>Nadroga/Navosa<br>Ba<br>Ra<br><br>Localities:<br>Sigatoka<br>Cuvu<br>Nadi<br>Ba<br>Tavua<br>Rakiraki | 1st Class<br>Very few limitations | Contour: Flat to nearly flat (0-3) degrees<br>Soil: Fertile, deep well drained and well suited for the establishment of pasture. | $975 | 1 Milking cow to 0.75 hectare or 75kg of butter fat per hectare | I |
| | 2nd Class<br>Moderate limitations | Contour: Flat to gentle Slopes (4-11) degrees<br>Soil: Reasonably fertile, fertilizer required for good pasture, low moisture retaining capacity. | $550 | 1 Milking cow to 1.25 hectare or 50kg of butter fat per hectare. | II + III |
| | 3rd Class<br>severe limitations | Contour: Moderates to steep slopes (12-20 degrees +)<br>Soil: low fertility, stony very low moisture retaining capacity | $180 | 1 Milking cow to 1.5 hectare or 40kg or less of butter fat per hectare | IV + V + VI |

NOTE:

(1) One or more of the advance factors pertaining to contour and soils could apply.

All the above yields are calculated on butter fat production from pasture only.

Location needs to be taken into account in determining the value.
The Remarks Column represents yields from an average farm under average management and are guidelines only.

## RICE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| (a) SOUTH EAST VITI LEVU<br><br>Provinces:<br>Tailevu<br>Rewa<br>Naitasiri<br>Namosi<br>Serua<br><br>Localities:<br>Rewa Valley<br>Vunidawa<br>Navua<br>Suva<br>Tailevu | 1st Class<br>Very few limitations | Contour: Flat to very gentle.<br>Slopes: (0-3) degrees<br>Soil: Fertile, heavy and good water retaining capacity.<br>Drainage: Good to fair | $3750 | 3 tonnes to 4.5tonnes and above of paddy per hectare | I + IIws |
| | 2nd Class<br>Moderate limitations | Contour: Flat to very gentle<br>Slopes: (0 – 7) degrees<br>Soil: Fertile to moderately fertile, lower water retaining capacity<br>Drainage: Good to moderate | $2250 | 2 tonnes to 3 tonnes of paddy per hectare | I + IIe + IIIws |
| | 3rd Class<br>Severe limitations to very severe limitations | Contour: Moderate slope (8-11) degrees.<br>Swampy flats<br>Soil: Fair/low fertility<br>Drainage: Fair to poor, extreme wetness, salinity Peaty. | $1500 | 2 tonnes and less of paddy per hectare | IIIe + IVws |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

Location needs to be taken into account in determining the value. The Remarks column represents yields from an average farm under average management and are guidelines only.

**RICE LAND**

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| (b) WEST VITI LEVU<br><br>Provinces:<br>Nadroga/ Navosa<br>Ba<br>Ra<br><br>Localities:<br>Sigatoka<br>Nadi<br>Lautoka<br>Ba<br>Tavua<br>Rakiraki<br>Dobuilevu | 1st Class Very few to moderate limitations<br>Contour: Flat to very gentle slopes (0-3) degrees | Soil: Fertile, heavy and good water retaining capacity.<br>Drainage: Adequate | $2250 | 2 tonnes to 3 tonnes and above of paddy per hectare | IIws |
| | 2nd Class<br>Severe limitations | Contour: Moderate slope (0-7 deg)<br>Swampy flats<br>Soil: Fair/low fertility<br>Drainage: Poor, high salinity | $1200 | 1.5 tonnes to 2 tonnes of paddy per hectare | I + Ie + IIIws |
| | 3rd Class<br>Severe limitations To very severe limitations | Contour: Moderate slope (8-11) degrees.<br>Swampy flats<br>Soil: Fair/low fertility<br>Drainage: Fair to poor, high salinity | $500 | 1.5 tonnes and less of paddy per hectare | IIIe + Ivws |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

Location needs to be taken into account in determining the value. The Remarks column represents yields from an average farm under average management and are guidelines only.

## RICE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| © VANUA LEVU & TAVEUNI | 1st Class Very few limitations | Contour: Flat Soil: Fertile, heavy and good water retaining capacity Drainage: Good | $2200 | 3 tonnes to 4.5 tonnes and above of paddy per hectare | IIws |
| Provinces: Bua Macuata Cakaudrove | 2nd Class Moderate limitations | Contour: Flat to very gentle slopes (0-7) degrees Soil: Fertile to moderately fertile Drainage: Good to moderate | $1200 | 2 tonnes to 3 tonnes and above of paddy per hectare | I + Iie + IIIws |
| | 3rd Class Severe limitations to very severe limitations | Contour: Moderate slope (8-11) degree. Swampy flats Soil: Fair/Low Fertility Drainage: Fair to poor, high salinity | $500 | 2 tonnes and less of paddy per hectare | IIIe + IVws |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply. Location needs to be taken into account in determining the value.

The Remarks column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| WEST SOUTH WEST VITI LEVU | 1st Class Arable. Flat very few limitations. Suited to wide range of crops. Permanent agriculture without improvements. High yield per hectare. Probable range of crops; sugarcane; tobacco; passion fruit; pine-apple and pulses. | Contour: Nearly level land (0-3) degrees Soil: Deep well drained, naturally fertile, minimum use of fertilizer, high moisture holding capacity; ordinary crop management practices to maintain productivity. | $12000 | Yields of 85 tonnes to 135 tonnes or more of sugarcane per hectare | I |
| Provinces: Nadroga/Na-vosa<br><br>Localities: Kavanagasau Olosara Cuvu Lomawai | 2nd Class Arable. Flat to gentle slopes moderate limitations. Suited to a wide range of crops as for 1st Class but lower yields per hectare. Permanent agri-culture without improvements. Probable range of crops; sugarcane; tobacco; broom corn; vegetables; pineapples, pas-sion fruits and pulses. | Contour: Slight change in that the land may be gently sloping (4-7) degrees. Slight to moderate erosion hazard. Soils: Lower natural fertility. Poor soil structure, restricted drainage, presence of gravel/sand and small stones. Application of fertilizer necessary. | $7500 | Yields of 50 tonnes or more of sugarcane per hectare but under 85 tonnes per hectare. | II |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply. With crops other than sugarcane, the declared UCV's would only apply if the net return from the land is similar or better than sugarcane.

Location needs to be taken into account in determining the value.

The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | **REMARKS** | **MAF LUC EQUIVALENT** |
|---|---|---|---|---|---|
| WEST SOUTH WEST VITI LEVU | 3rd Class Arable. Moderately steep. Severe limitations. Suited to narrow range of crops; lower yield per hectare; some improvements required. Probable range of crops: sugarcane; vegetables, pineapples and pulses. | Contour: Moderately steep slopes (8-15) degrees High erosion hazards. Soils: shallow, moderately fertile. Requires intensive erosion control measures and fertilizer application | $3750 | Yields of 35 tonnes or more sugarcane per hectare but under 50 tonnes per hactare. | III + IV |
| Provinces: Nadroga/ Navosa<br><br>Localities: Kavanagasau Olosara Cuvu Lomawai | Marginal Arable. Steep slopes. Very severe limitations. Suited to a very limited range of crops other than sugarcane; lowest yields per hectare. Major improvements required. | Contour: Steep slopes (16-20 deg +) severe erosion hazards; wet flats. Difficult to drain. Soils: very infertile. Very shallow and low moisture retaining capacity. Major conservation measure and heavy dosage of fertilizer required. | $1350 | Yields of under 35 tonnes of sugarcane per hectare. | V + VI |

NOTES:
(1) One or more of the adverse factors pertaining to contour and soils could apply.
With crops other than sugarcane, the declared UCV's would only apply if the net return from the land is similar or better than sugarcane
Location needs to be taken into account in determining the value.
The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| NORTH WEST VITI LEVU<br><br>Provinces:<br>Ba/Nadroga/ Navosa (part)<br><br>Localities:<br>Nadi (including Nawai and Nawaicoba up to Momi)<br>Lautoka and Ba up to Vatia Point Junction. | First Class Arable. Flat land. Very few limitations Suited to a wide range of crops. Permanent agriculture without improvements; higher yields per hectare. Probable range of crops; sugarcane; tobacco; passion fruits; vegetables; pineapples and pulses. | Contour: Nearly level land (0-3) degrees.<br>Soils: Deep, well-drained, naturally fertile, minimum use of fertilizer, high moisture holding capacity – ordinary crop management practices to maintain productivity. | $12800 | Yields of 85 tonnes to 135 tonnes or more of sugarcane per hectare | I |
| | Second class arable. Flat to gentle slopes. Moderate limitations. Suited to wide range of crops as for first Class but lower yields per hectare. Permanent agriculture without improvements. Probable range of crops: sugarcane; tobacco; passion fruit; vegetables; pineapples and pulses. | Contour: Slight change in that the land may be gently sloping (4-7) degrees. Slight to moderate erosion hazard.<br>Soils: Lower natural fertility. Poorer soil structure, restricted drainage, presence of gravel/ sand and small stones. Application of fertilizer required. | $8300 | Yields of 50 tonnes or more of sugarcane per hectare but under 85 tonnes per hectare. | II |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

With crops other than sugarcane, the declared UCV's would only apply if the net return from the land is similar or better than sugarcane

Location needs to be taken into account in determining the value.

The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVA-LENT |
|---|---|---|---|---|---|
| NORTH WEST VITI LEVU<br><br>Provinces:<br>Ba & Nadroga/ Navosa (part)<br><br>Localities:<br>Nadi (including Nawai and Nawaicoba up to Momi)<br>Lautoka and Ba up to Vatia Point Junction. | 3rd Class arable. Moderately steep. Severe limitations. Suited to a narrow range of crops; lower yield per hectare; some improvements required. Probable range of crops: Sugarcane; vegetables; pineapples and pulses. | Contour: Moderately steep slopes (8-15) degrees. High erosion hazards. Soil: Shallow, moderately fertile. Require intensive erosion control measures. Application of fertilizer required. | $4000 | Yields not specified because of large range of crops which could be grown. | III + IV |
| | Marginal arable. Steep slopes. Very severe limitations. Suited to a very limited range of crops other than sugarcane. Lowest yield per hectare. Major improvements required. | Contour: Steep slopes (16-20 deg +) severe erosion hazards; wet flats, difficult to drain. Soils: Very infertile. Very shallow and low moisture retaining capacity. Rocky. Very badly drained. Major conservation measures and heavy dosage of fertilizer required. | $1500 | Yields not specified because of large range of crops which could be grown. | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.
(2) Location needs to be taken into account in determining the above.
(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| NORTH WEST VITI LEVU<br><br>Provinces: Ra and part of Ba<br><br>Localities: Tavua Rabulu Rakiraki Dobuilevu | First Class arable. Flat very few limitations. Suited to a wide range of crops. Permanent agriculture without improvements. High yields per hectare. Probable range of crops: Sugarcane; tobacco; vegetables; pineapples and pulses. | Contour: Nearly level land (0-3) deg. Free draining. Soils: Fertile. Low water table. Suited to permanent agriculture with ordinary crop management practices. Minimum application of fertilizers required. | $12000 | Yields of 85 tonnes to 135 tonnes or more of sugarcane per hectare. | I |
| | Second class arable. Flat to gentle slopes. Moderate limitations. Suited to a wide range of crops as for First Class but lower yields per hectare. Permanent agriculture without improvements. Probable range of crops: Sugarcane; tobacco; vegetables; pineapples and pulses. | Contour: As for First Class but slight increase in slopes (4-7) degrees. Erosion hazards. Soil fertile. Slightly higher water table. Presence of gravel/sand. Application of fertilizer re-quired. | $7500 | Yields of 50 tonnes or more of sugarcane per hectare but under 85 tonnes per hectare. | II |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.
(2) With crops other than sugarcane, the declared UCV's would only apply if the net return from the land is similar or better than sugarcane.
(3) Location needs to be taken into account in determining the value.
(4) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVA-LENT |
|---|---|---|---|---|---|
| NORTH WEST VITI LEVU<br><br>Provinces:<br><br>Ra and part of Ba<br><br>Localities:<br><br>Tavua<br><br>Rabulu<br><br>Rakiraki<br><br>Dobuilevu | Third Class arable. Moderately steep, severe limitations. Suited to a narrow range of crops. Improvements required. Lower yields per hectare. Probable range of crops: sugarcane; vegetables; pineapples; and pulses. | Contour: Moderately steep slopes (8-15 deg). High erosion hazard. Soils: Shallow, sticky permitting cultivation only during certain periods. Liable to dry out during dry seasons. Moderately fertile; require intensive erosion control measure. Application of fertilizer necessary. | $3750 | Yields of 35 tonnes or more of sugarcane per hectare but under 50 tonnes per hectare. | III + IV |
| | Marginal arable. Steep slopes. Very severe limitations. Major improvements required. Suited to a very limited range of crops other than sugarcane. Lowest yields per hectare. | Contour: Steep slopes (16-20 deg+) severe erosion hazards; wet flats, difficult to drain. Soils: Very infertile. Very shallow and very low moisture retaining capacity. Rocky and bouldery. Very badly drained. Major conservation measures and heavy dosage of fertilizer required. | $1350 | Yields of under 35 tonnes of sugarcane per hectare. | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) With crops other than sugarcane, the declared UCV's would only apply if the net return from the land is similar or better than sugarcane.

(3) Location needs to be taken into account in determining the value.

(4) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| ALL CANE GROWING AREAS IN VANUA LEVU<br><br>Province: Macuata | Ist class arable. Flat very few limitations. Suited to a wider range of crops. Permanent agriculture without improvements. High yields per hectare. Probable range of crops: sugarcane; tobacco; vegetables; pineapples; and pulses. | Contour: Nearly level land (0-3) degrees. Soils: Deep, well-drained naturally fertile, minimum use of fertilizer. High moisture holding capacity. Ordinary crop management practices to maintain productivity. | $10000 | Yields of 85 tonnes to 135 tonnes or more of sugarcane per hectare. | I |
| Localities:<br>Wainikoro<br>Bucaisau<br>Labasa<br>Vunimoli<br>Waiqele<br>Seaqaqa | 2nd Class arable. Flat to gentle slopes. Moderate limitations. Suited to a wide range of crops as for First Class but lower yields per hectare. Permanent agriculture without improvements. Probable range of crops: sugarcane, tobacco; vegetables; pineapples and pulses. | Contour: Slight change in that the land may be gently sloping (4-7) degrees. Slight to moderate erosion hazards. Soils: Lower natural fertility. Poor soil structure, restricted drainage. Presence of gravel or sand and small stones. Application of fertilizer required. | $6250 | Yields of 50 tonnes or more of sugarcane per hectare but under 85 tonnes per hectare. | II |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) With crops other than sugarcane, the declared UCV's would only apply if the net return from the land is similar or better than sugarcane.

(3) Location needs to be taken into account in determining the value.

(4) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| ALL CANE GROWING AREAS IN VANUA LEVU<br><br>Province: Macuata<br><br>Localities: Wainikoro Bucaisau Labasa Vunimoli Waiqele Seaqaqa | 3rd Class Arable. Moderately steep. Severe limitations. Suited to a narrow range of crops. Some improvements required. Lower yields per hectare. Probable range of crops: sugarcane; vegetables; pineapples; and pulses. | Contour: Moderately steep slopes (8-15) deg. High erosion hazards. Soils: shallow, moderately fertile. Require intensive erosion control measures. Fertilizer application necessary. | $3100 | Yields of 35 tonnes or more of sugarcane per hectare but under 50 tonnes per hectare | III + IV |
| | Marginal Arable. Steep slopes. Very severe limitations. Undulating contour including 'Bua' series soils. Suited to a very limited range of crops other than sugarcane. Lowest yields per hectare. | Contour: Steep slopes (16-20deg. +) severe erosion hazards; wet flats difficult to drain. Soil: very infertile, very shallow, very low moisture retaining capacity. Subject to serious sheet erosion. Rocky. Very badly drained. Major conservation measure and heavy dosage of fertilizer required. Deep but very infertile and subject to serious sheet erosion (Bua series). | 1100 | Yields of under 35 tonnes of sugarcane per hectare. | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) With crops other than sugarcane, the declared UCV's would only apply if the net return from the land is similar or better than sugarcane.

(3) Location needs to be taken into account in determining the value.

(4) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| ALL AREAS OUTSIDE THE CANE PERIMETER<br><br>Province:<br>Macuata<br>Bua<br>Cakaudrove<br>Lau<br>Lomaiviti<br>Kadavu | 1st Class Arable. Flat, very few limitations. Suited to a wide range of crops. Permanent agriculture without improvements. High yields per hectare. Probable range of crops: vegetables, pineapples, pulses, tobacco and root crops. | Contour: Nearly level land (0-3) degrees. Soils: Deep, well-drained naturally fertile, minimum use of fertilizer. High moisture holding capacity. Ordinary crop management practices to maintain productivity. | $2250 | Yields not specified because of large range of crops which could be grown. | I |
| | 2md Class Arable: Flat to gentle slopes. Moderate limitations. Suited to a wide range of crops as for First Class but lower yield per hectare. Permanent agriculture without improvements. Probable range of crops: Vegetables, pineapples, pulses, tobacco and root crops. | Contour: Slight change in that land may be gently sloping (4-7) degrees. Slight to moderate erosion hazard. Soils: Lower natural fertility. Poor soil structure restricted drainage, presence of gravel, sand and small stones. Application of fertilizers necessary. | $900 | Yields not specified because of large range of crops which could be grown. | II |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.
(2) Location needs to be taken into account in determining the value.
(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVA-LENT |
|---|---|---|---|---|---|
| ALL AREAS OUTSIDE THE CANE PERIM-ETER<br><br>Province:<br>Macuata<br>Bua<br>Cakaudrove<br>Lau<br>Lomaiviti<br>Kadavu | 3rd Class Arable. Moderately steep, severe limitations. Suit-ed to a narrow range of crops; lower yield per hectare; some improvements required. Prob-able range of crops: vegeta-bles, pineapples, root crops. | Contour: Moderately steep slopes (8-15) degrees. Moderate to high erosion hazards.<br><br>Soils: Shallow, moderately fer-tile. Requires intensive ero-sion control measures and fertilizer appli-cation. | $450 | Yields not specified because of large range of crops which could be grown. | III + IV |
| | Marginal Arable. Steep slopes. Very severe limitations. Suited to a very limited range of crops. Lowest yields per hectare. Major improvements required. | Contour: Steep slopes (16-20 deg +) severe erosion hazards; wet flats, difficult to drain. Soils: Very infertile. Very Shallow and low mois-ture retain-ing capacity. Rocky. Very badly drained. Major con-servation measures and heavy dosage of fertilizer required. | $150 | Yields not specified because of large range of crops which could be grown. | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) Location needs to be taken into account in determining the value.

(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| SOUTH & SOUTH EAST VITI LEVU<br><br>Provinces:<br>Serua/ Namosi<br>Parts of Rewa and Naitasiri<br><br>Localities:<br>Deuba<br>Navua<br>Suva<br>Koronivia<br>Toga | 1st Class Arable. Flat, very few limitations. Suited to wide range of crops. Permanent agriculture without improvements. High yields per hectare. Probable range of crops: vegetables, pineapples, pulses, tobacco and root crops. | Contour: Nearly level land (0-3) degrees. Soils: Deep well-drained, naturally fertile, minimum use of fertilizer, high moisture holding capacity; ordinary crop management practices to maintain productivity. | $8250 | Yields not specified because of large range of crops which could be grown. | I |
| | 2nd Class arable. Flat to gentle slopes, moderate limitations. Suited to a wide range of crops as for First Class but lower yields per hectare. Permanent agriculture without improvements. Probable range of crops: vegetables, pineapple, pulses, tobacco and root crops. | Contour: Slight change in that the land may be gently sloping (4-7) deg. Slight to moderate erosion hazard. Soils: Lower natural fertility. Poorer restricted drainage, preence of gravel/ sand and small stones. Application of fertilizer necessary. | $5250 | Yields not specified because of large range of crops which could be grown. | II |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) Location needs to be taken into account in determining the value.

(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| SOUTH & SOUTH EAST VITI LEVU<br><br>Provinces:<br><br>Serua/<br><br>Namosi | 3rd Class Arable. Moderately steep, severe limitations. Suited to a narrow range of crops; lower yields per hectare; some improvements required. Probable range of crops; vegetables; pineapples; roots crops. | Contour: Moderately steep slopes (8-15) deg. Moderate to high erosion hazards.<br><br>Soils: Shallow, moderately fertile. Requires intensive erosion control measures and fertilizer application. | $2250 | Yields not specified because of large range of crops which could grown. | III + IV |
| Parts of Rewa and Naitasiri<br><br>Localities:<br><br>Deuba<br><br>Navua<br><br>Suva<br><br>Koronivia<br><br>Toga | Marginal arable. Steep slopes. Very severe limitation. Suited to a very limited range of crops. Lowest yields per hectare. Major improvements required. | Contour: Steep slopes (16-20 deg +) severe erosion hazards; wet flats, difficult to drain. Soils: very infertile. Very shallow and low moisture retaining capacity. Rocky. Very badly drained. Major conservative measures and heavy dosage of fertilizer required. | $1100 | Yields not specified because of large range of crops which could be grown. | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) Location needs to be taken into account in determining the value.

(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| SOUTH & SOUTH EAST VITI LEVU<br><br>Provinces:<br>Tailevu<br>Rewa<br>Naitasiri<br><br>Localities:<br>Rewa Valley<br>Vunidawa<br>Waibau<br>Tailevu | 1st Class Arable. Flat, very few limitations. Suited to wide range of crops. Permanent agriculture without improvements. High yields per hectare. Probable range of crops; vegetables; pine-apples, pulses, tobacco and root crops. | Contour: Nearly level land (0-30 degrees. Soils: Deep well-drained, naturally fertile, minimum use of fertilizer, high moisture holding capacity, ordinary crop management practices to maintain productivity. | $3750 | Yields not specified because of large range of crops which could be grown. | I |
| | 2nc Class Arable. Flat to gentle slopes moderate limitations. Suited to a wide range of crops as for First Class but lower yields per hectare. Permanent agriculture without improvements. Probable range of crops: vegetable, pineapples, pulses, tobacco and root crops. | Contour: Slight change in that the land may be gently sloping (4-7) deg. Slight to moderate erosion hazards. Soils: lower natural fertility. Poorer soil structure, restricted drainage, presence of gravel/sand and small stones. Application of fertilizer necessary. | $2250 | Yields not specified because of large range of crops which could be grown. | II |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) Location needs to be taken into account in determining the value.

(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| b) SOUTH & SOUTH EAST VITI LEVU<br><br>Provinces:<br>Tailevu<br>Rewa<br>Naitasiri<br><br>Localities:<br>Rewa Valley<br>Vunidawa<br>Waibau<br>Tailevu | 3rd Class Arable. Moderately steep. Severe limitations. Suited to a narrow range of crops; lower yield per hectare; some improvements required. Probable range of crops: vegetables, pineapples, root crops. | Contour: Moderately steep slopes (8-15) deg. Moderate to high erosion hazards. Soils: Very shallow moderately fertile. Requires intensive erosion control measures and fertilizer application. | $1125 | Yield not specified because of large range of crops which could be grown. | III + IV |
| | Marginal Arable. Steep slopes. Very severe limitations. Suited to a very limited range of crops. Lowest yields per hectare. Major improvements required. | Contour: Steep slopes (16-20) deg. Moderate to high erosion hazards. Soils: very shallow, moderately fertile. Requires intensive erosion control measures and fertilizer application. | $450 | Yield not specified because of large range of crops which could be grown. | V =VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) Location needs to be taken into account in determining the value.

(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| TAVEUNI<br><br>Province: Cakaudrove<br><br>Locality: Taveuni | 1st Class. Very few limitations. | Contour: Flat to nearly flat (0-7) degrees. Soil: Deep well-drained naturally fertile, clay loam to sandy loam. | $975 | Average yield of dried copra 1 tonne per hectare and above. | I + II |
| | 2nd Class. Moderate limitations | Contour: Gentle slopes (8-11) deg up to 400 feet above sea level. Soil: Reasonable fertility and depth, moderately stony, including coastal sand of reasonable fertility. | $975 | Average yield of dried copra 800 kg and under 1 tonne per hectare | III |
| | 3rd Class. Severe limitations | Contour: Moderate slopes (12-15) deg up to 500 feet above sea level. Soil: Moderate to low fertility needs fertilizer, stony and bouldery. | $375 | Average yield of dried copra 400 kg and under 800 kg per hectare. | IV |
| | Marginal. Very severe limitations | Contour: Steep slopes (16-20 deg +) up to 900 feet above sea level. Soil: Shallow, very low fertility. Very stony and bouldery. Heavy dressings of fertilizer necessary. Poor drainage. | $225 | Average yield of dried copra 400 kg per hectare and less | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) No poorly drained land in 2nd and 3rd Classes.

(3) Location needs to be taken into account in determining the value.

(4) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## TREE CROPS COCONUTS

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| LOMAIVITI, LAU & VANUALEVU<br><br>Province:<br>Lomaiviti<br>Lau<br>Cakaudrove<br>Bua<br><br>Locality:<br>Ovalau<br>Koro<br>Gau<br>Lau<br>Batiki<br>Bua<br>Natewa<br>Savusavu<br>Buca Bay | 1st Class. Very few limitations. | Contour: Flat to nearly flat (0-7) degrees. Soil: Deep well-drained naturally fertile, clay loam to sandy loam. | $750 | Average yield of dried copra 800 kg per hectare and above. | I + II |
| | 2nd Class. Moderate limitations | Contour: Gentle slopes (8-11) deg up to 400 feet above sea level. Soil: Reasonable fertility and depth, Some stones also includes coastal sand of reasonable fertility. | $375 | Average yield of dried copra 400 kg and under 800 per hectare | III |
| | 3rd Class. Severe limitations | Contour: Moderate slopes (12-15) deg up to 500 feet above sea level. Soil: Reasonably deep, low fertility needing fertilizer. Moderately stony. | $225 | Average yield of dried copra 300 kg and under 400 kg and under 800kg per hectare. | IV |
| | Marginal. Very severe limitations | Contour: Steep slopes (16-20 deg +) up to 900 feet above sea level. Soil: Shallow, very low fertility. Very stony and bouldery. Heavy dressings of fertilizer necessary. Poor drainage. | $110 | Average yield of dried copra 300 kg per hectare and less | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) No poorly drained land in 2nd and 3rd Classes.

(3) Location needs to be taken into account in determining the value.

(4) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## TREE CROPS
## COCONUTS

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| © KADAVU, YASAWAS BEQA VATULELE MAMANUCAS | 1st Class. Very few limitations | Contour: Flat to nearly flat (0-7) degrees. Soil: Deep well-drained naturally fertile, clay loam to sandy loam. | $675 | Average yield of dried copra 800 kg per hectare and above. | I + II |
| | 2nd Class. Moderate limitations | Contour: Gentle slopes (8-11) deg up to 400 feet above sea level. Soil: Coastal sand of reasonable fertility and depth- some stones. | $375 | Average yield of dried copra 400 kg and under 800 per hectare | III |
| | 3rd Class. Severe limitations | Contour: Moderate slopes (12-15) deg up to 500 feet above sea level. Soil: Low fertility, shallow, stony. | $225 | Average yield of dried copra 300 kg and under 400 kg per hectare. | IV |
| | Marginal. Very severe limitations | Contour: Steep slopes (16-20 deg +) up to 900 feet above sea level. Soil: Poor, very low fertility. Poor drainage | $110 | Average yield of dried copra 300 kg per hectare and less | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.
(2) No poorly drained land in 2nd and 3rd Classes.
(3) Location needs to be taken into account in determining the value.
(4) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## TREE CROPS
## COCONUTS

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| d) VITI LEVU AREAS WITHIN 20 KILOMETERS OF COAST | 1st Class. Very few limitations | Contour: Flat to nearly flat (0-7) degrees. Soil: Deep well-drained naturally fertile, clay loam to sandy loam. | $750 | Average yield of dried copra 800 kg per hectare and above. | I + II |
| | 2nd Class. Moderate limitations | Contour: Gentle slopes (8-11) deg up to 400 feet above sea level. Moderately wet flats and coastal sand. Soil: Reasonably fertile including coastal sands. Imperfect drainage. | $375 | Average yield of dried copra 400 kg and under 800 per hectare | III |
| | 3rd Class. Severe limitations | Contour: Moderate slopes (12-15) deg up to 500 feet above sea level. Soil: Low fertility- needs fertilizer. | $180 | Average yield of dried copra 300 kg and under 400 kg per hectare | IV |
| | Marginal. Very severe limitations | Contour: Steep slopes (16-20 deg +) up to 900 feet above sea level. Soil: Poor, very low fertility. Poor drainage | $110 | Average yield of dried copra 300 kg per hectare and less | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) No poorly drained land in 2nd and 3rd Classes.

(3) Location needs to be taken into account in determining the value.

(4) The Remarks Column represents yields from an average farm under average management and are guidelines only.

## ARABLE LAND

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| WEST VITI LEVU ALL THE AREAS OUTSIDE THE CANE PERIMETER.<br><br>Provinces:<br>Nadroga/ Navosa<br>Ba<br>Ra | Ist Class Arable. Flat, Very few limitations. Suited to wide range of crops. Permanent agriculture without improvements. High yields per hectare. Probable range of crops; vegetables; pineapples; pulses; tobacco and root crops.. | Contour: Nearly level land (0-3) degrees. Soils: Deep well-drained, naturally fertile, minimum use of fertilizer, high moisture holding capacity; ordinary crop management practices to maintain productivity. | $8000 | Yields not specified because lf large range of crops which could be grown. | I |
| Localities:<br>Sigatoka<br>Nadi<br>Lautoka<br>Ba<br>Tavua<br>Rakiraki<br>Dobuilevu | 2nd Class Arable. Flat to gentle slopes moderate limitations. Suited to wide range of crops as for First Class but lower yields per hectare. Permanent agriculture without improvements. Probable range of crops: vegetables, pineapples, pulses, tobacco and root crops. | Contour: Slight change in that the land may be gently sloping (4-7) deg. Slight to moderate erosion hazards. Soils: Lower natural fertility. Poorer Soil structure, restricted drainage, presence of gravel/sand and small stones. Application of fertilizer necessary | $5000 | Yields not specified because of large range of crops which could be grown. | II |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) Location needs to be taken into account in determining the value.

(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.

**ARABLE LAND**

| LOCATION | CLASSIFICATION | DESIGNATION | UCV (PER HECTARE) | REMARKS | MAF LUC EQUIVALENT |
|---|---|---|---|---|---|
| WEST VITI LEVU ALL THE AREAS OUTSIDE THE CANE PERIM-ETER.<br><br>Provinces:<br>Nadroga/ Navosa<br>Ba<br>Ra<br><br>Localities:<br>Sigatoka<br>Nadi<br>Lautoka<br>Ba<br>Tavua<br>Rakiraki<br>Dobuilevu | 3rd Class Arable Moderately steep, severe limitations. Suited to a narrow range of crops; lower yield per hectare; some improvements required Probable range of crops: vegetables; pineapples; root crops. | Contour: Moderately steep slopes (8-15) deg. Moderate to high erosion hazards. Soils: Shallow, moderately fertile. Requires intensive erosion control measures and fertilizer application. | $2500 | Yield not specified because of large range of crops which could be grown. | III + IV |
| | Marginal Arable. Steep slopes. Very severe limitations. Suited to a very limited range of crops. Lowest yield per hectare. Major improve-ments required. | Contour: Steep slopes (16-20 deg +) severe erosion haz-ards; wet flats, difficult to drain. Soils: very infertile. Very moisture retaining capac-ity. Rocky. Very badly drained. Major conservation measures and heavy dosage of fertilizer required. | $1250 | Yield not specified because of large range of crops which could be grown. | V + VI |

NOTES:

(1) One or more of the adverse factors pertaining to contour and soils could apply.

(2) Location needs to be taken into account in determining the value.

(3) The Remarks Column represents yields from an average farm under average management and are guidelines only.



## A4.6 Land Tenure

Freehold : is the most complete estate which can be held and is subservient only to the crown. Property with a freehold title has a ready market and is the most easily traded title. As a result it also represents the best loan security and may be used as a security for mortgage purpose.

Leasehold tenure is a right of use which is granted by the lad owner (the lessor) to another person the (lessee). The major lessors in Fiji are the Native Land Trust Board and the Crown. However, freehold land may also be leased by the owners. The lessee's interest in the land will vary according to the type of lease and lease conditions. Long term

renewable leases, or leases with rights of compensation for improvement, that may be transferred with minimum limitation may provide an opportunity of the lessee to invest with confidence in farm improvements and to develop an increased equity or interest in the farm. These leases are reasonable loan security and finance may be borrowed against the lessee's interest.

Short term leases, or leases with limitations on use or transfer, have less appeal to farmers and consequently the value of the lessee's interest may ne quite small and unsuitable for loan security.

The broad distribution of ownership of land in Fiji as shown below will indicate the type of tenure that prevails in Fiji. Native Land cannot be alienated except in exceptional circumstances. Both can be leased.

## A 4.7 CROWN LEASES

Crown Leases are issued under the provision of the Crown Lands Act and Regulations made thereunder.

Native Leases are issued under the provisions of the Native Land Trust Act and Regulations made thereunder

Leases issued by the Crown are classed as follows:-

**Class**

| | |
|---|---|
| A | Agricultural Lease |
| B | Residential Leases |
| C | Commercial Leases |
| D | Grazing Leases |
| E | Garden Leases |
| F | Dairying Leases |
| G | Tramway Leases |
| H | Quarry Leases |
| I | Special leases |

The Native Leases are also classified as above except that an additional class known as Class J is granted to Native Fijians in a Native reserve

Control of all native land is vested in the Native Land Trust Board and is administered by the Board for the benefit of the Fijian owners. Agricultural leases issued by private owners are limited in number.

The provisions of the Agricultural Landlord and Tenant Act apply to all agricultural land in Fiji except agricultural holdings of an area less than 2 ½ acres. The Act may be made applicable to holding less that 2 ½ acres.

There are certain other exceptions provided by the Act and Regulations made thereunder.

The most important provisions of the Act are:-

Security of tenure to the tenant;
Control of rents of agricultural tenancies;

Payment of compensation by a landlord for improvements effected by a tenant;
Application of certain statutory conditions to agricultural tenancies;
Statutory periods for reassessment of rent
The provision of a tribunal to which a landlord and tenant may apply in case of dispute
Limitation on and control of share farming;
Damages to the landlord in case of deterioration.

## A4.8 FIJIAN LAND TENURE

(This section has been prepared by the Native Land Trust Board Regional Planning Unit)

Fiji consists of some 4.5 million acres (1.821 million ha) of land. Approximately 3.7 million acres (1.497 million ha) some 83% are Fijian owned; less than .39 million acres (156,418 ha) (9%) are Crown land; freehold land was obtained by gift or purchase, mainly prior to cession. Crown land principally consists of land unclaimed at the time of cession, areas purchased by Government, and Fijian land whose owners have died out. Shortly after cession in 1874, legislation was enacted prohibiting the sale of Fijian land except to the Crown. This ban was lifted between 1904 and 1909, but has been in effect since.

As in the case with many of the indigenous peoples of the South Pacific, the life of the Fijian is very much bound up with the land. It represents his major source of security, and is the only permanent material asset he and his children possess. The social customs and nature of the Fijian are such that it is almost impossible for him to acquire, (or rather, retain), what more sophisticated societies regard as material assets. The Fijian, therefore, places tremendous value of his land and title to it. He regards retention of title to the land as the essential safeguard of his heritage. This is particularly important in the context of the politico-racial development of Fiji, with its attendant problems both current and potential. The Fijian is extremely reluctant to part with title to the land, even to government, because such land could be alienated to others.

The Fijian system of land tenure is , basically, one of entailed freehold, and is closely tied to the Fijian social structures. The Fijian way of life is cased on closely related family groups living together in villages, cultivating well-defined land areas originally acquired by conquest or occupation of empty land. Several such family groups, claiming descent from a common ancestor, are linked in a larger social unit – the mataqali. For official registration of land titles, the mataqali has been adopted as the proprietary unit. There are some 6,000 such units registered, with membership ranging from a single individual to several hundred, and having title to land - sometimes more than one area – ranging from less than one acre to tens of thousands of acres in extent. The overall average is some 600 acres (242.82 ha) per unit. Fiji thus consists of a patchwork of mainly Fijian owned land with no really large areas of land under a single title.

### Fijian Land Policy

Fijian have for may years leased heir land to other races for agricultural and other purposes. The early method was by direct approach to and negotiation with the land owning unit. If agreement was reached , government approval was granted. This method was haphazard and unsatisfactory from a number of aspects.

In 1940, with the consent of the Fijian people Native Land Trust Board was established, as a non-government corporate body, to handle the management of Fijian lands. This Board, in effect, act as an estate agency; it arranges leases, collects and distributes rents, and is responsible for supervision of lease conditions. The enacting legislation also made

provision for the creation of reserves, solely for Fijian use for current and future needs, where alien leases are not permitted. The NLTB's standard leases contain provisions intended to enforce good husbandry, but, while it can exert pressure in extreme cases, the board has not the staff to do as much as is desirable in this connection.

The NLTB is financed by 25% of rents and 10% of royalties collected. The Turaga-i-Taukei or head of the vanua receives 5% of all rents and royalties, the Turaga ni qali or head of the yavusa 10% of dues in his yavusa, the turaga ni mataqali 15% of those due in his mataqali. When the land holding involved can be identified as belonging to a specific Tokatoka the following provision is made:

Provided that when a mataqali is sub divisible into persons or bodies of persons known by the Fijian term tokatoka, and such tokatoka is the owner of the land leased, the balance of such sum instead of being paid to the mataqali, as above provided, shall be distributed equally among the members of such tokatoka.

The result is that the rank and file members of the mataqali (or tokatoka) divide 50.75% of the rents and 61.25% of the royalties from their leased land. There is a great variation in the extent to which the "chiefs" involved spend their rent shares on community expenses or for their personal use. The great inconsistencies in the amount received from land rents and in the land available for use from one mataqali to the next is, of course, due mainly to the natural inequalities in extent and quality of land holdings.

The 17% of the land in Fiji which is under freehold or Crown ownership accounts for a good proportion of the best land in terms of agricultural potential and accessibility. Although some freehold land has passed into Indian hands, the bulk of it is European owned; Indian farmers are mostly tenants of sub-tenants on native lands. Of the 3.7 million acres(1.497 million ha) of native land, 1.005 million acres (406,686 ha) is alienated by lease (.295 million acres (119,281 ha) to Fijian). Most of the remainder of the native land is in Native Reserve and not available for lease to non-fijians. This land can be de-reserved only when it can be shown that it is not necessary for the current or future needs of the mataqali, and consent for its release can ne gained from the owning unit

A great deal of the unutilized native land is of unstable steepland soils, a small proportion of which may be useful for tree crops, but much of which should be kept under forest for conservation purposes. In many areas shifting garden cultivation is still the most rational usage of the land. Much of the remaining native land consists of talasiga of low fertility, swamps which would need expensive reclamation, and grazing land; there is not much unused residue.

**Agricultural Land Use**

Despite the increased pressure on the land due to increasing population, and the attendant urbanization of Fiji, 63% of the population remains in the rural areas, dependent largely on agriculture, forestry, and fishing for their livelihood. As regards the two major population components; 69% of the Fijians remain in rural areas, and 61% of the Indians.

Of the unemployed population of Fiji, the agriculture, forestry, fisheries sector account for 44% of the total. Fijians find 57% of their employment within this sector and the Indians 40% of the 1.005 million acres (406,689 ha) of leased native lands,.672 milliion acres (272,039 ha) are agricultural leases, (.24 million acres (97,126 ha) are grazing leases, and .13 million acres 852,610 ha) are forest leases.

Of the agricultural leases, cane leases account for the largest amount of acreage and rev-

enue by far. Cane farming is still a predominantly Indian activity, although Fijian cane farmers are becoming increasingly important. Indians received four times as many contracts (from the Fiji Sugar Corporation) in 1976 as did Fijians. The Indian cane farmers in the same year. The production on Indian farms runs much higher than on Fijians farms, but there is evidence that this may be due to the more marginal lands the Fijians are farming. In the Seaqaqa cane scheme, where nearly equal numbers of cane leases were issued to Indians and Fijians, the production figures are even.

In the cane areas there has been strong pressure on the soil and a good deal of disguised subdivision, with the buying of leases or shares in them at enhanced and uneconomic premium. These transactions are of course extra-legal or illegal, but very difficult to control.

Copra growing, which produces Fiji's next biggest export crop, is predominantly a Fijian activity. Copra has a smaller return per acre than has cane. Most copra is grown on native lands, although there are some large European freehold estates involved in copra production.

Despite the increasing urbanization and diversity of Fiji's economy, the population remains predominantly rural and the economy largely dependent on its agricultural sector, particularly sugar cane. Most of the cane land in production is leased from the NLTB to Indian cane farmers. The Fijian is making sow but steady progress in his transition from subsistence to commercial farming. Although there is some possibility of opening new lands for agricultural production, e.g the Seaqaqa Cane Scheme, Pine Afforestation Schemes, Cattle Grazing Schemes, the Hydroelectric Scheme, a great deal of Fiji's agricultural development will have to come from more efficient use of existing agricultural areas.

The Fijian will continue to feel the need for the security of his land. Reconciliation of the need to respect traditional land rights and lifestyles with the accelerating need for agricultural productivity and diversification will continue to be Fiji's greatest development challenge. The co-operation of the NLTB and the various government ministries will be increasingly necessary if Fiji successfully to meet this challenge.

**Footnotes**

Native Land Trust (cap 134), sec 33, Native Land (Lease and Licenses) Regulations, Part I 3 (1);
Native Land Trust Board, Electronic Data Processing Unit;
1976 Fiji Census of Population
1976 Fiji Census of Population
Native Land Trust Board, Electronic Data Processing
Fiji Sugar Corporation, 1976 Statistics



**Partition of Land in Fiji**
**In thousand acres (in thousand hectares)**

| | | |
|---|---|---|
| Fijian tribal land of Which there is leased | 1,004 | (406) |
| Fijian freehold | 12 | (4.856) |
| Crown freehold | 75 | (30.352) |

| | | |
|---|---|---|
| Other freehold | 447 | (180.898) |
| Freehold total | 534 | (216.107) |
| Crown Schedule A (Land of extinct mataqali) | 120 | (48.563) |
| Crown Schedule B | 88 | (35.613) |
| (Land unclaimed at Cession) | 4,498 | (1,820.282) |

## A4 NATIVE LAND TRUST BOARD AND LEASES

Function of NLTB:-
Briefly the function of Native Land Trust Board are as follows:-

To control and administer all native land for the benefit of the Fijian landowners;
To reserve adequate land for the maintenance and support of the Fijian landowners;
To lease out land outside native reserves in vie of the economic development of the country as a whole;
To secure realistic rents for the Fijian landowners in the leasing of such land;
To prevent the wasteful system of the haphazard leasing of the most fertile land leaving poorer land unused.

**Agricultural leases**
Of over 3.7 million acres (1.497 million ha.)of native land, 671,936 acres (272,039 ha) are presently held under agricultural, pastoral and afforestation leases.

There is scope to open up more land for agricultural development but this must be viewed in the need to boost agricultural production. It will need careful consideration for proper land use planning, the availability of funds to meet costs of infrastructure, the creation market outlets, the establishment of sound farm support services and many other provisions to make such development a viable proposition.

There are 2 main classes of agricultural leases administered by NLTB. The first one is known as Class A, and this includes all agricultural leases granted to people of any race on land outside native reserves. The other is termed class J agricultural leases which are approved to Fijians only over land within native reserves. The main difference between these two categories is that Class A does come under the ambit of ALTA whereas class J is exempted from that Act. Another difference is that while the Class A can be negotiated freely in the open market for the purposes of transfer, mortgage etc., the class J can only be encumbered with restricted conditions to certain institutions recognized by NLTB.

**Policy**
The present policy of the NLTB rules out the issues of agricultural leases on ad hoc basis and to non-bona fide farmers. Ad hoc leases do not allow effective administration and supervision of such leases.

The NLTB encourages planned development of large areas of native land to maximize their potential and to take advantage of government and overseas technical assistance to provide management skills, funds and infrastructure services. Experience has shown that the haphazard leasing of land in isolated pockets creates more problems of development and a costly lease administration.

An example of this move by NLTB is clearly illustrated in the development of Seaqaqa, Uluisaivou and the Yalavou beef cattle scheme.

**Tenure**

The tenure of all agricultural, dairying, grazing and afforestation leases are as follows:-

| | | | |
|---|---|---|---|
| Class A | Agricultural leases | now | 30 years |
| Class J | " | | 30 years |
| Dairying | " | | 30 yrs |
| Grazing | " | | 30 yrs |

**Afforestation Leases**

| | |
|---|---|
| Pine Scheme | 60 yrs |
| Mahogany or Hardwood Scheme | 99 yrs |

The rental for Native Leases are as follows:-

| | | | |
|---|---|---|---|
| ha | Agricultural | $ 34.60 a/c | $85.46 |
| ha | Dairying | $13.00 | $32.11 |
| ha | Grazing | $3.00 | $8.15 |
| ha | Commercial/industrial | $8.54 | $21.09 |
| ha | Hotel/resort | $108.54 | $268.09 |
| ha | Residential | $25.98 | $64.17 |
| ha | Government | $.55 | $1.36 |
| ha | Educational | $3.30 | $8.15 |
| ha | Religious | $8.41 | $20.77 |
| ha | Recreational | $10.00 | $24.70 |
| ha | Quarrying | $1.96 | $4.84 |
| ha | Tramways | $3.67 | $9.06 |
| ha | Afforestation | $2.16 | $5.34 |
| ha | Development | $17.16 | $42.39. |
| ha | Other | $.26 | $.64 |

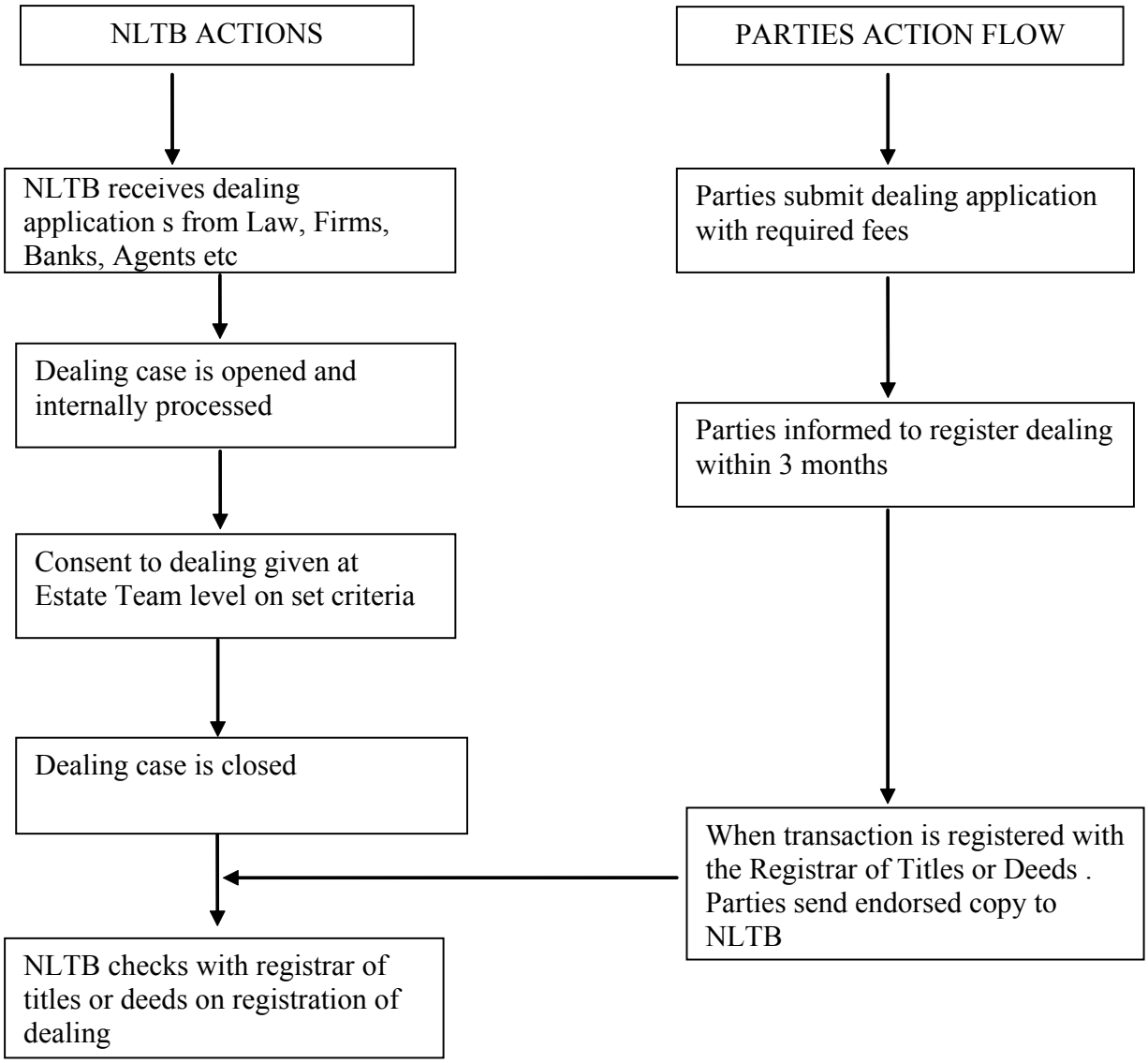
The following documents are provided for ready reference:-

Native Land Trust (Leases and Licenses) (Amendments) Regulations, 1974
Condition of Agricultural Lease 9Class A-Agriculture)
Condition of Grazing Lease (Class D – Grazing)
Application of Lease Native Land

Flow chart showing NLTB processing stages

## NATIVE LAND TRUST BOARD

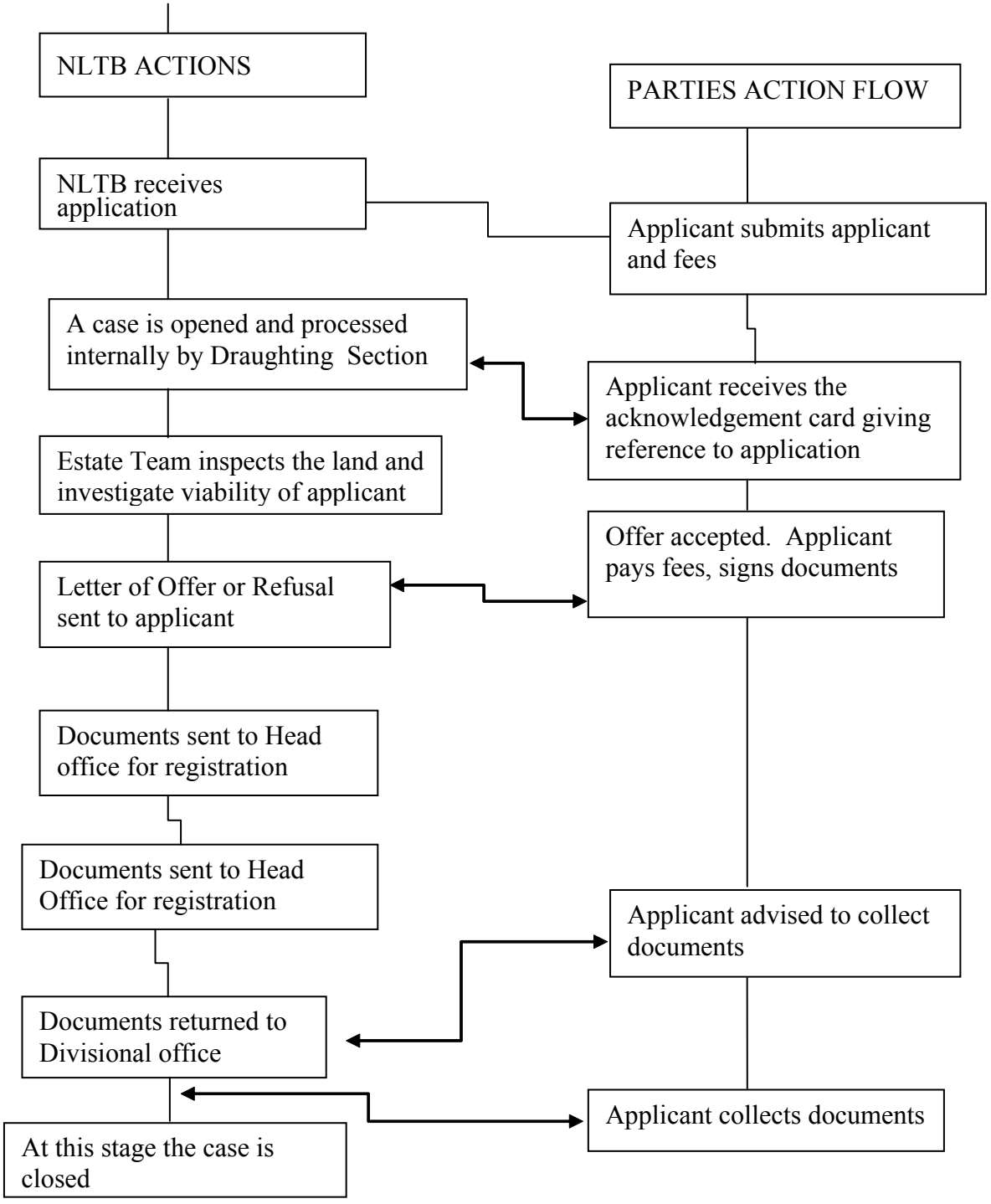
Stages of processing Application to dealing of Assignment or Mortgage of a Lease




**Flow chart showing NLTB processing stages**

**NATIVE LAND TRUST BOARD**

Stages of processing application to lease native Land from NLTB




**Native Land Trust Act**
**(Chapter 134)**
**(Native Land Trust (Leases and Licenses)**
**(Amendment) Regulations, 1974**

Revised 1985 Subsidiary Legislation

Third Schedule
(Regulation 7)
Scale of Fees

(Payable to the Native Land Trust Board)
Description of matter

(2) (1)

On application for a lease or license……...……$30
Reparation of planning application and submission
Department of Town and Country Planning, on behalf of applicant…….....….$50
Issuing a Survey instructions to applicants appointed land surveyor
for preparation Of survey diagrams…….....……$50
Preparation and processing of lease documents for registration
under the Land Transfer Act …….....……$60
Preparation and issuing of an Instrument of Tenancy (ALTA),
or an Agreement for lease…….....$60

Application for, and issue of, certified copy of title document;
advertising costs, plus…..... $50

Issue of license…….....…… $50

On preparation of a variation document for lease or tenancy (but excluding that required
for an increase in rent and a statutory extension under the …….....……$40

Agriculture landlord and Tenant Act……$40
Application for the consent of the Board to the mortgaging of and……$30
Application for the consent of the Board to the subletting of land……..……$30
Application for the consent of the board to the transfer of land……..……$50
Application for the subdivision of land (i.e a surrender of part of the land included in a
lease and its re-leasing in one or more lots to third parties)…….....……$50
Search Fee……..……$5
Application for approval of plans of building or other improvements
9 excluding installation of water meters.....……$30
Application for approval of installation of water meter……..……$5
Other matters A fee commencement with the work involve

**CONDITION OF AGRICULTURE PURPOSES**

25. All leases for agricultural purposes shall be subjected, in addition to any other conditions which the Board in the circumstances of the case may see fit to impose, to the following conditions:-

That the lessees shall within a specific number of years and under permanent improvements, which may include fencing, as may be specified in the lease;
That the lessee shall plant with crops in a good husband manner within the first five years of the lease one-fifth of the land suitable for cultivation; at least two-fifths of the said area within the first ten years of the lease; at least three-fourths of the said area within the first twenty years of the lease; and at least three-fourths of the land suitable for cultivation shall be kept planted as aforesaid for the remainder of the term of the least;

That the lessee shall manure the portions of the land planted as aforesaid and shall keep the whole in good condition and shall not allow any part to become impoverished and shall use such artificial or other manure as may be required by the lessor or an officer

authorized by the lessor in that behalf in writing;

That the lessee shall apply such measures to check soil erosion as may be required by the lessor in writing and shall maintain such measures to the satisfaction of the lessor or of an officer appointed by the lessor in writing. Such measure shall include one or more of the following: strip, cropping, terracing, contour planting, cover cropping, rotation of cropping, construction of drains or dams, and construction of fences;

That the lessee shall not fell trees or clear or burn off bush or cultivate any land within a distance of twenty-four feet from the bank of a river or stream.

That the lessee shall not cultivate any crops within thirty-three feet of the centre of any public road or on a slope exceeding thirty-five degrees from the horizontal.

28. A lease for grazing purposes shall be subject to the following special conditions in addition to any conditions which the Board in the circumstances of any case may see fit to impose:-

That the lessee shall within a specific number of years and under penalty of re-entry effect to the satisfaction of the lessor, such permanent improvements, which shall include fencing, as mat be specified in the lease;

That if the Board is satisfied during any period of the lease that any portion of the land is being used for agricultural purpose otherwise than for growing crops for the used of stock or persons employed upon the land the Board shall have the right to reassess the rent of the land so used subject to penalty of re-entry should the lessee not accept such reassessment of rent;

That the lessee shall stock the land at a minimum rate of one head of cattle or five sheep per goats per sixty- four acres within the first five years of the lease and at a minimum rate of two head of cattle or ten sheep or goats per sixty-four acres within ten years of the date of commencement of the lease and that the land shall be kept stocked as last aforesaid for the remainder of the term;
That the lessee shall not clear, burn off, cultivate or permit uncontrolled grazing of the top twenty-five per cent of hills (as measured vertically) having a slope exceeding twenty-five degrees from the horizontal;

That the lessee shall apply such measures to check soil erosion as may be required by the lessor in writing and shall maintain those measures to the satisfaction of the lessor or of an officer appointed by the lessor in that behalf in writing. Such measures may include the restriction of grazing, terracing, construction of drains or dams and the construction of fences;

That the lessee shall not, without the prior consent of the lessor in writing, take, use or otherwise injure any forest tree growing upon the demised land except for the purpose of clearing the land of for the planting of grass or of erecting fences or buildings incidental to the use of the land for grazing purpose.



**Condition of lease for gardening purpose**

**29.** A lease for gardening purpose shall be subject to the following special conditions in addition to any other conditions which the Board in the circumstances of any case may see for to impose:-

(a) that the demised land shall be used solely as a nursery vegetables or pleasure garden or orchard, as the case may be;

(b) that the lessee shall manure the land and carry out any other measures, including green maturing and rotation of cropping, as the lessor, form time to time, to conserve the fertility of the soil;

(c) that a fixed sum shall be expended by the lessee in permanent improvements which shall be such as the lessor may decide in each case within a specific number of years under penalty of re-entry.

# FORMS OF OWNERSHIP





- FORMS OF OWNERSHIP
- PRIVATE INDIVIDUAL OR DOLE TRADER
- PARTNERSHIP
- COMPANY
- CO-OPERATIVE
- TRUST
- LEASING
- SHARE FARMING

## FORMS OF OWNERSHIP

The organization of the ownership of a farm, or the various assets of a farm, may follow a number of forms depending upon:-

The amount of capital available
The number of people involved
The size of the enterprise
The length of ownership and family involvement
The legal capacity or management capacity of the owners

The organization may be divided into two broad groups. Firstly the group which could be considered as single entity ownership. The forms of ownership within this group are:-

Private individual or sole trader
Partnership
Company
Cooperative
Trust
The Law relating to 2-5 are contained in the Laws of Fiji 1978 Edition Chapters 248,250,66,65.

The second group could be considered as double or multiple entity ownership forms such as:-

Leases
Share farming
In this latter group although people will own the same type of assets as people in the first grouping, differentiation is in dividing ownership of the asset in to rights of owning, and rights of use.

**Definition : Single Entity**

This term has been selected in order to describe those forms of ownership organizations that locate actual ownership within a single individual or a group of people who have come together in a common business interest. The main features of these forms of organization are summarized in the following section.

## PRIVATE INDIVIDUAL OR SOLE TRADER

This is when the business is owned by one person which in many instances is the individual farmer. The main advantages are:-

Management: the management is vested in the owner who is free to make decisions upon the operations of the farm. Alternatively he may delegates the day to day management to an employed manager.
The owner is free to contract, i.e sell, purchase or employ

**Disadvantages**

The owner must find all capitals needed to purchase and operate the farm;
The owner has unlimited liability and his creditors have a claim on his personal possessions should be become bankrupt
The owner is subject to the individual tax code. There is no sharing of income to minimize taxation
His interest in the farm is passed on to his heirs on his death, but it may be necessary to sell the property to meet estate duties or requirements of his will.
Under this form of ownership which is probably the most common form in Fiji, the owner has the maximum freedom of action, but also the maximum liability for his actions, and is solely responsible for the capital investment.

PARTNERSHIP
A partnership is a relationship which exist between persons carrying on a business in common with a view of profit. It is an agreement between 2 or more people, but the upper limit is generally treated as 20 persons after which it may be considered as a company for tax purposes.

**Advantages**

The management is vested in the partners, but may be allocated by formal agreement
Each partner is free to contract on behalf of the partnership unless limited by agreement and this is known to all parties.
The capital required to purchase and operate the business is share between the partners. Hence the amount of capital needed by each partner is less than if he were to purchase the business as a sole trader. However, the amount may still be substantial.

Disadvantages

There is unlimited liability and creditors may have a claim on the partners personal possessions;
Each partner is liable for contract or debts created by other partners and a partner must honour the pledge or act relating to the business until his death
Every partner is liable jointly with co-partners, and severally for the liabilities of the business. He is also liable for the wrong doings of other partners and must make good, misappropriation of goods belonging to a third party
The partnership may have to be dissolved upon the bankruptcy, retirement, or death of a partner.
All partners are entitled to share equally in capital or profits of the business and must also contribute equally; unless as agreement is made to the contrary. Partners making payment on behalf of the business are entitled to reimbursement.

No partner may introduce another partner without the consent of all existing partners and no change in the nature of the partnership can be made without the consent of all partners. Any difference arising with ordinary business is to be decided by a majority.

Partnerships are a very useful form of sharing the responsibilities of a farm and are frequently found in family arrangements, e.g between a father and two sons, or between sons.

## COMPANY

There are two main forms of companies
Private companies, where membership is limited with a minimum of two and maximum of fifty (2-50) shares are not available to the Public
Public companies where shares are available to the public and membership is unlimited excepting that there is a minimum of seven shareholders

**Companies have two main legal documents:-**
Memorandum of association which is a deed setting out the details of the company
Articles of Association which sets out the duties and management of the company.

**Companies may have different degrees of liability**
Limited liability where the liability of share holder is limited to the unpaid amount if any upon the shares held by each shareholder.
Limited liability – where there is no share holding but liability is limited to an amount which the members respectively undertake to contribute to the assets of the company in the event of its being wound up. A guarantee.
Companies may be limited by both shares and by guarantee
Unlimited company- a company which has no limit on the liability of shareholders or members;

The main features of a company are:-

It is comprised of a number of members who agree to finance an enterprise usually by a system of shares. Membership ranges from 2-50 for privates, and above 7 for public companies;

Liabilities of members are usually limited to the unpaid portion of share held;
The formation of a company is under the companies Act;
The assets of the company belong to the company and not to its members
A company is a separate legal entity and may be sued;
The capital of the company may be held in small parcels of shares by individuals;
Management of the company is vested in the Directors under the provisions of the Articles of Association;
A member or shareholder is not an agent of the company and has not authority to bind the company;
Alterations to the company's constitution must be carried out under the provisions of the Act;
Transfer of shares or interest is made under the provisions of the Articles of Association, and death or bankruptcy of individual members or shareholders does not dissolve or affect the continuance of the company;
Companies have a separate tax code.

## SHARE FARMING

Share farming is a method by which young men with limited capital may enter farming. In these agreements the share farmer supplies labour, or labour plus management, while the landowners supplies, land, plant and capital. There may be two main categories:-

(i ) Labour – only share agreements

Usually where a labour – only share agreement has been entered into, the share farmer receives a percentage may be set at 30% of the gross income. This percentage may be set at 30% of the gross income, but is subject to negotiation and circumstances. Under these agreements the land owner manages the property and provides land, stock, plant, and working capital. He may also pay all the operating costs. The share farmer will undertake all work and may have to find further labour should he be unable to manage on his own.

(ii) Labour, Livestock, Plant and Management Share Agreements.

Where the share farmer also provides the management skills, he will also be required to provide livestock and plant. In these arrangements the gross income is usually divided in half but it again subject to negotiation and 60/40 terms may be found
The running costs of the farm are usually divided so that the land holder pays for farm rent and the maintenance of the farm, while the share farmer meets all farm running costs such as labour, seeds, fertilizer, machinery costs, freight.
Share agreements can be beneficial to both land holder and share farmer provided they assess the farm carefully, budget correctly and save, may be able to use share agreements to accumulate capital and to progress towards farm ownership as follows:-

| Type | Capital Required | Reward |
|---|---|---|
| Labour only share | No capital | 30% gross income |
| Labour Management | Stock & plant | 50% gross income |
| Leasehold | Stock, plant & value of Improvements. Working Capital | all gross income rent 6% |
| Freehold | Total capita less mortgages | All gross income |

With all forms of ownership care needs to be taken when purchasing:-

The agreement should be read carefully with completed understanding
The farm should be inspected thoroughly
Budgets should be prepared and used as tools to ensure that there is a fair sharing of rewards, and in particular, that adequate income will be earned by the share farmer.

## Index for appendix 5 Forms of Ownership

Present there is insufficient data available to determine the interest return to total capital but it is likely to range from zero to fifteen percent (0-15%) after making allowances for wages of management. This return will be influenced by:-

Value of land
Productivity
Prices of farm products
Skill and effort of the farmer

In addition to this interest return on total capital invested there will be a growth in the value of the land which is usually called a capital gain. For land that may be traded i.e freehold and some crown and NLTB leases, land value will steadily increase over time due to:-
Demands of an increasing population
Changes in technology
Change in ,Market and profitability
Availability of capital

This increase will be shown in the unimproved value where it may be readily identified as capital gain. It will also appear in increases in capital value of farms, but part of this change will be due to investment by the farmer, as well as the increase in the cots of farm improvements due to inflation. It id likely that the rate of capital annum with an average somewhere in the five to ten percentage range. However again in this information is not available and though field personnel should be aware of this factor it should also be appreciated that the rate varies due to many factors.

People with freehold land may lease to others due to:-

**Lack of interest in farming**
*Age*
Desire to retain land ownership due to possible future benefits i.e (i) family needs (ii) capital gain. Leases are frequently taken by people who wish to be farmers but who have insufficient money to buy a freehold, or by people who wish to increase their farming activities without involving large amounts of additional capital.

*Leases on Stock and Plant*
Such leases are not common, but arrangements may be found particularly where properties are being passed onto other members of a family. Again, the value of the assets may be used as a basis for setting a rental with reasonable low interest rates on livestock, but high rates on plant to take into account depreciation and deterioration. The return on capital invested in livestock and machinery may be quite high given sound management, and gross margin analysis would suggest return of 20-50% on livestock and 30-100% on crops.

This return is used to finance land improvements, as well as labour and personal living needs. Given reasonable land rents, a farmer by astute management may make better use of his money by acquiring a lease and devoting more of his capital to his farming activities than by acquiring a small area of freehold.

**SHARE FARMING**

Share farming is a method by which young men with limited capital may enter farming. In these agreements the share farmer supplies labour, or labour plus management, while the landowner supplies, land, plant and capital. There may be two main categories:-

**Labour – only share agreements**

Usually where a labour- only share agreement has been entered into, the share farmer receives a percentage of the gross income. This percentage may be set at 30% of the gross income, but is subject to negotiation and circumstances. Under these agreements the land owner manages the property and provides land, stock, plants and working capital. He may also pay all the operating costs. The share farmer will undertake all work and may have to find further labour should he be unable to manage on his own.

(ii) Labour, Livestock, Plant & Management Share Agreements

Where the share farmer also provides the management skills, he will also be required to provide livestock and plant. In these arrangements the gross income usually divided in half but is again subject to negotiation and 60/40 terms may be found. The running costs of the farm are usually divided so that the land holder pays for farm rent and the maintenance of the far, while the share farmer meets all farm running costs such as labour, seeds, fertilizer, machinery costs, freight.

Share agreements can be beneficial to both land holder and share farmer provided the level of production is sufficient to meet the needs of both families.

It may provide a useful start to young men without capital, who provided they assess the farm carefully, budget correctly and save, may be able to use share agreements to accumulate capital and to progress towards farm ownership as follows:-

| Type | Capital Required | Reward |
|---|---|---|
| Labour only share | No capital | 30% gross income |
| Labour Management | Stock & plant | 50% gross income |
| Lease hold | Stock, plant & value of | All gross income rent |
| 6% improvements. | Working capital | |
| Freehold | Total capital less mortgages | All gross income |

# BIOSECURITY PROMULGATION 2008

REPUBLIC OF FIJI ISLANDS GOVERNMENT GAZETTE
PUBLISHED BY AUTHORITY OF THE FIJI GOVERNMENT
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[1987]

INTERIM GOVERNMENT OF THE REPUBLIC OF THE FIJI ISLANDS

———

BIOSECURITY PROMULGATION 2008
(PROMULGATION NO. 28 OF 2008)

ARRANGEMENT OF SECTIONS

NTERIM GOVERNMENT OF THE REPUBLIC OF THE FIJI ISLANDS

———

BIOSECURITY PROMULGATION 2008
(PROMULGATION NO. 28 OF 2008)

IN EXERCISE of the powers conferred upon the Interim Government by virtue of the Interim Government Promulgation 2006 to make laws for the peace, order and good government of the Fiji Islands or any part thereof with respect to any matter whatsoever;

AND UPON the exercise of my own deliberate judgment as President of the Republic of the Fiji Islands as to what is best and good for the beloved people of the Fiji Islands;

AND UPON the exercise of the executive authority of the State in accordance with section 85 of the Constitution;

I, Josefa Iloilovatu Uluivuda, on the advice of the Cabinet, promulgate this Law—

TO PREVENT THE ENTRY OF ANIMAL AND PLANT PESTS AND DISEASES INTO THE FIJI ISLANDS; TO CONTROL THEIR ESTABLISHMENT AND SPREAD IN THE FIJI ISLANDS; TO REGULATE THE MOVEMENT OF ANIMAL AND PLANT PESTS AND DISEASES AND OF ANIMALS AND PLANTS AND THEIR PRODUCTS; TO FACILITATE INTERNATIONAL COOPERATION IN RESPECT OF ANIMAL AND PLANT DISEASES; AND FOR RELATED MATTERS

## PART 1 — PRELIMINARY

*Short title*

1.—(1) This Promulgation may be cited as the Biosecurity Promulgation 2008.

*Interpretation*

2.—(1) In this Promulgation, unless the context otherwise requires;—

"aircraft" means any conveyance that may be used in navigation by air;

"animal" means any mammal (other than a human), bird, insect, amphibian, reptile, fish, mollusk, sedimentary species or other member of the animal kingdom, whether alive or dead, and includes the egg, embryo, ova or semen and any organic animal tissue from which another animal could be produced, and the hide, skin, hair, feathers, shell, horns, hoof, viscera or any other part or portion of the body of an animal;

"animal product" means any article or substance derived from an animal, whether or not in combination with any other article or substance, and includes –

*(a)* meat, fat, milk, whey, cream, butter, cheese, eggs and other foodstuffs derived from an animal;

*(b)* the dung, urine, faeces, saliva, bone or blood of an animal, or any article or substance derived from the dung, urine, faeces, saliva, bone or blood of an animal;

*(c)* the secretions of any animal; and

*(d)* any product or biological preparation derived from any animal tissue or animal secretion;

"article" means a single unit of any goods;

"authorised" means duly authorised by the Minister, the Board, or biosecurity officer for the purposes of this Promulgation;

"Authority" means the Biosecurity Authority of the Fiji Islands established by section 8;

"baggage" means any goods which accompany a passenger or crew member on a conveyance, including clothing and any article attached or otherwise connected to the body or clothing of any passenger or crew member;

"ballast water" means water (including sediment that is or has been contained in water) used as ballast in a vessel;

"biosecurity" means the control by legal and administrative means of pests and diseases affecting animals, plants and their products, in order to avoid adverse effects from such pests and diseases on the economy and health of the Fiji Islands;

"biosecurity access arrangements" means arrangements under section 35(1) for specifications in respect of new imports;

"biosecurity approved premises" means premises approved for the inspection, testing and treatment of regulated articles under section 88;

"biosecurity authority" of a receiving country means the authority or officer in that country which administers its biosecurity Laws;

"biosecurity certification requirement", in relation to an article, means a requirement by a receiving country for a sanitary or phytosanitary certificate or a certificate of origin in respect of the article;

"biosecurity clearance", in respect of a regulated article or consignment, means biosecurity import clearance or biosecurity export clearance;

"biosecurity clearance agent" means a person in the Fiji Islands appointed by an importer or exporter under section 21 for the purposes of this Promulgation as the agent of the importer or exporter to supervise the biosecurity clearance of a conveyance, container, animal, plant, animal or plant product or any other goods;

"biosecurity control" of a regulated article means submission of the article for inspection under this Promulgation, and thereafter taking such biosecurity measures, or permitting such measures to be taken, as are directed pursuant to this Promulgation, until biosecurity clearance is granted in respect of the article;

"biosecurity controlled area" means an infested biosecurity controlled area declared under section 70 or a pest-free biosecurity controlled area declared under section 72;

"biosecurity declaration" in relation to an article or consignment means a written statement of the nature, quantity and origin of the article or consignment, and of other details relating to it required by or under this Promulgation;

"biosecurity emergency" means the incursion or suspected incursion of a regulated pest or disease into any area of the Fiji Islands, or the existence of some other biosecurity threat, which requires urgent action, whether by eradication, containment or other response, and for which the powers under this Promulgation are not otherwise adequate;

"biosecurity emergency area" means an area declared in response to a biosecurity emergency under section 77;

"biosecurity entry inspection" of an incoming article means inspection of it pursuant to section 31;

"biosecurity export clearance" of an article means permission under section 46 for the article or consignment to be exported;

"biosecurity export inspection" of an outgoing article means inspection of it pursuant to section 41;

"biosecurity goods holding area" means an area of land at or adjacent to a seaport or airport designated under section 19(3) for the biosecurity inspection of incoming or outgoing articles and consignments;

"biosecurity holding area" means a biosecurity port holding area, a biosecurity goods holding area or a biosecurity postal holding area;

"biosecurity import clearance" of an article means permission under section 33 for the article or consignment to be removed from a biosecurity holding area;

"biosecurity import clearance inspection" of an incoming article means inspection of it pursuant to section 32;

"biosecurity import permit" means a biosecurity import permit issued under section 37;

"biosecurity import requirements" in relation to an article or consignment mean—

*(a)* the conditions of a biosecurity import permit, if one is required;

*(b)* the requirements of any sanitary or phytosanitary certificate relating to the article or consignment;

*(c)* any other biosecurity measures specified under section 34(1)(c);

"biosecurity inspection" of an incoming or outgoing conveyance, article or consignment means an inspection to ascertain whether the conveyance, article or consignment presents a biosecurity risk to the Fiji Islands or a receiving country and whether in other respects it conforms to the requirements of this Promulgation;

"biosecurity landing clearance" means clearance for a vessel or aircraft to land cargo or passengers under section 23;

"biosecurity measure" means the inspection, detention, quarantining, testing, treatment, re-consignment or destruction of a regulated article to eliminate or reduce the biosecurity threat presented by the article;

"biosecurity officer" means—

*(a)* the CEO and the Deputy CEO;

*(b)* any person appointed as a biosecurity officer under section 11;

*(c)* in respect of any particular function, a biosecurity officer to whom the function has been assigned or delegated under section 11 or 13;

"biosecurity point of departure" means a seaport, airport designated under section 18(4) for the exportation of regulated articles;

"biosecurity point of entry" means a seaport, airport designated under section 18(1) for the importation of regulated articles;

"biosecurity port holding area" means an area designated under section 19(1) for the biosecurity inspection of incoming vessels or aircraft;

"biosecurity port quarantine" means quarantine of a vessel or aircraft in a biosecurity port quarantine area under section 24;

"biosecurity port quarantine area" means an area designated under section 24(1) for the quarantine of vessels and aircraft;

"biosecurity port quarantine clearance" means permission under section 27 for a vessel or aircraft to unload passengers and cargo after being in biosecurity port quarantine;

"biosecurity postal holding area" means an area of a mail exchange designated under section 19(5) for the biosecurity inspection of incoming or outgoing postal items;

"biosecurity quarantine" means confinement in isolation of a regulated article and any conveyance, container or packaging in which the article is carried, for inspection, testing and/or treatment; in order to prevent or limit the entry, introduction, establishment or spread of a regulated pest or disease;

"biosecurity quarantine station" means a facility under the control of the Authority and designated under section 48 for the performance of biosecurity quarantine, and includes a temporary biosecurity quarantine station;

"biosecurity register" means the register kept by the Authority under section 81;

"biosecurity risk" means the likelihood of the introduction, establishment or spread of a pest or disease which would adversely affect animals, plants, human beings, the environment or economic activities, and the likely extent of such harm;

"biosecurity risk assessment" in relation to a regulated article means evaluation of the biosecurity risk posed by the article;

"biosecurity specifications" means biosecurity import specifications made under section 34 or biosecurity export specifications made under section 44;

"biosecurity threat" means the threat of harm being caused or adverse effects resulting to animals, plants, human beings, the environment or economic activities as a result of the introduction, establishment or spread of a regulated pest or disease;

"Board" means the Board of the Authority constituted under section 8;

"captain", in relation to an aircraft, means the person for the time being in command or control of the aircraft;

"CEO" means the Chief Executive Officer of the Authority appointed under section 10(1);

"compliance agreement" means an agreement between the Authority and another person as provided for in section 87;

"consignment" means a quantity of goods which arrive in the same vessel or aircraft and which in accordance with this Promulgation can be covered by a single import permit or sanitary or phytosanitary certificate;–

"container" means anything in which or by which goods are encased, covered, enclosed or packed, including any material in contact with the goods;

"contamination" means the presence in any item of a pest, not constituting an infestation;

"conveyance" means a ship, aircraft, vehicle or other means of transporting people, goods or animals from one location to another, while it is being used or prepared for such transport;

"country of origin" includes a re-exporting country;

"custodian", in respect of an item, means the occupier of a place or the person in possession and charge of an article, whether lawfully or not, but does not include a person who has possession or control of the item only for the purpose of taking biosecurity measures in respect of it;

"Deputy CEO" means the person appointed as Deputy Chief Executive Officer under section 10(1);

"disease" means any unhealthy condition in an animal or plant which is known or suspected to be caused by an organism, and includes a disease transmissible from animals to humans and a disease capable of harming the environment;

"document" means any mode of communicating information in a retrievable form, including electronically;

"environment" includes—

*(a)* the ecosystem and its constituent parts, including people and communities;

*(b)* all natural and physical resources;

*(c)* the qualities and characteristics of locations, places and areas.

"eradication" means the application of measures to eliminate a pest or disease from an area;

"establishment", in relation to a pest or disease, means the perpetuation in an area of the pest or disease for the foreseeable future after its entry into the area;

"export" means to take or send goods out of the Fiji Islands;

"exporter" means a person who exports or seeks to export goods, other than as the master of the vessel or captain of the aircraft in which the goods are carried; and includes a biosecurity clearance agent;

"fittings" means any stall, box, cage, enclosure, pen, net or other material used for penning, yarding, confining or containing any animal and includes any harness, saddlery, rope, bucket, trough, bedding, utensil or implement used in the handling or keeping of animals or animal products;

"fodder" means any water, meat, vegetables, grain or material used for the food or litter of animals, or the storage of animal products;

"functions of the Authority" means the functions set out in section 9;

"garbage" means waste material derived in whole or in part from plants, fruit, vegetables, meat or other plant or animal material, or other refuse of any kind that has been associated with any plants, fruits, vegetables, meat or other plant or animal material;

"genetic material" means any material of plant, animal, microbial or other origin containing functional units of heredity;

"goods" means any kind of moveable property or thing;

"host material" means any packing material, container, fittings, litter, manure, fodder or similar goods that might have had contact with animals or plants or their products;

"import" means to bring goods, or cause goods to be brought, into the Fiji Islands;

"importer" means a person who imports or seeks to import goods, other than as the master of a vessel or captain of the aircraft in which the goods are carried; and includes a biosecurity clearance agent;

"in transit", in relation to goods, means the goods are not imported into an area but pass through it to another area, whether by the same or another conveyance, during which time they remain enclosed, are not split up, are not combined with other goods, and do not have their packaging changed;

"infected", in relation an animal or plant, means that the animal or plant is diseased or may have been exposed to the risk of infection during the preceding 6 months;

"infested", in relation an item or area, means that there is present in the item or area a living pest or disease;

"inspection", in relation to an item, means an official examination of the item to determine if any pest or disease is present in the item and whether in other respects the item conforms to the requirements of this Promulgation;

"IPPC" means the International Plant Protection Convention of the Food and Agriculture Organization of the United Nations;

"introduction", in relation to a pest or disease, means the entry of the pest or disease into an area, resulting in its establishment in the area;

"item" means any kind of moveable or immoveable property or thing, including premises;

"living organism" means any organism capable of transferring or replicating genetic material, including sterile organisms, viruses, viroids, plasmids, bacteriophages and prions;

"local authority" means the District Office, Provincial Administration Office, and Municipal Office;

"master", in relation to a vessel, means the person for the time being in charge or control of the vessel, not being the pilot;

"microbe" means any organism or biotic entity of microscopic proportions, whether unicellular, multicellular or sub-cellular in common form;

"Minister" means the Minister who has responsibility for the administration of this Promulgation; and "Ministry" means the Ministry of that Minister;

"notifiable pest or disease" means a pest or disease which is declared under section 75(1) to be notifiable;

"OIE" means the Organisation Internationale Epizoötique;

"operator" means the operator or owner of the facilities which have been declared as the biosecurity point of entry and departure under this Promulgation.

"organism" means a biotic entity capable of reproduction or replication (other than a human);

"packing material" means any fabric, paper, cardboard, plastic, wood, straw, grass or leaves used in packing any goods, and any other type of material in which goods are covered, enclosed, contained or wrapped;

"pest" means any species, strain or biotype of a plant, animal, microbe or pathogenic agent, or any organism, which—

*(a)* causes disease; or

*(b)* is detrimental to or capable of harming or adversely affecting animals or animal products, plants or plant products, human beings or the environment;

"pest risk analysis" means the evaluation by a qualified person of biological or other scientific and economic evidence to determine whether a pest or disease should be regulated and the nature of any biosecurity measures to be taken against it;

"phytosanitary certificate" means a certificate relating to a plant or plant product which—

*(a)* is issued by the biosecurity authority of the country of origin or re- exporting country;

*(b)* certifies that the plant or plant product is substantially free from plant pests and diseases and in other respects meets the plant health import requirements of the receiving country; and

*(c)* is patterned after the model certificates of the IPPC;

"plant" includes seeds, germplasm, any other part of a plant and a dead or preserved plant;

"plant material" means any unmanufactured material of plant origin, including grain;

"plant product" means—

*(a)* plant material;

*(b)* timber; and

*(c)* any product manufactured wholly or partly from one or more plants;

"PPPO" means the Pacific Plant Protection Organisation;

"precautionary principle" means the principle that it is not unreasonable to refuse permission for an activity that has great potential negative impact, even if there is not sufficient scientific data to support a refusal, as incorporated in Article 5.7 of the SPS Agreement;

"premises" means any immoveable property, other than land;

"prescribed" means prescribed by this Promulgation or by regulations made under it;

"prohibited import" means a regulated article the importation or ownership of which is prohibited under section 17;

"re-exporting country", in relation any goods, means a country which is not the country of origin of the goods, but where a container or consignment of goods is opened and re-packed for export;

"receiving country" means a country which is the intended destination of an article being or proposed to be exported;

"reconsign", in relation to a regulated article or consignment which has been refused biosecurity import clearance, means to send the article or consignment out of the Fiji Islands, either by the vessel or aircraft on which it was imported or by another vessel or aircraft;

"regulated article" means—

*(a)* any animal or animal product;

*(b)* any plant or plant product;

*(c)* any living organism, whether modified or not;

*(d)* soil, sand gravel and aggregate;

*(e)* any genetic material;

*(f)* human remains;

*(g)* any host material;

*(h)* a regulated pest or disease;

*(i)* any clothing, machinery or other article that contains or has adhering to it anything mentioned in paragraph (a), (b), (c) or (d);

*(j)* garbage;

*(k)* any other article, substance, goods or thing declared by the Minister by order under subsection (2) to be a regulated article for the purposes of this Promulgation;

"regulated consignment" means a consignment of regulated articles;

"regulated pest or disease" means a pest of disease –

*(a)* the importation of which into the Fiji Islands is prohibited or restricted under section 16; or

*(b)* which is under official control;

"regulations" means regulations, orders and any other subsidiary legislation made under this Promulgation;

"repealed laws" means the Promulgation and subsidiary legislation repealed by section 107(1);

"sanitary certificate" means an international health certificate relating to an animal or animal product which—

*(a)* is issued by the biosecurity or agricultural Authority of the country of origin or re-exporting country;

*(b)* certifies that the animal or animal product is substantially free from animal pests and diseases and in other respects meets the animal health import requirements of the receiving country; and

*(c)* complies with relevant requirements of the SPS Agreement or the exporting country, as the case may be;

"ship s stores" means any food or other regulated articles carried on a vessel or aircraft for consumption or use on the vessel or aircraft;

"specified", in relation to a requirement, document, procedure or any other matter, means specified by the Authority under section 105;

"spread", in relation to a pest or disease, means the expansion of the geographical distribution of the pest or disease within an area;

"SPS Agreement" means the World Trade Organisation Agreement on the Application of Sanitary and Phytosanitary Measures;

"status", in relation to a pest or disease, means its presence, absence, prevalence, incidence, distribution and occurrence in an area;

"technical section head" means the technical section head of the Authority;

"test" means an examination which goes beyond a visual inspection, to determine if a pest or disease is, or is likely to be, present or to identify a pest or disease, and includes chemical tests of plant material and diagnostic tests in respect of an animal;

"timber" includes round wood, sawn wood, wood chips and dunnage, with or without bark;

"treatment" means an authorised procedure for the killing, removal, modification or rendering infertile or non-viable of a pest or disease by way of cleansing, fumigation, inoculation, disinfection, disinfestation, decontamination, or otherwise;

"uncleared", in relation to a regulated article, means that the article has not received biosecurity clearance;

"under official control", in relation to a pest or disease, means that its presence is known, its distribution is limited and its further spread is controlled by the exercise of powers under this Promulgation;

"vehicle" includes a bicycle (whether motorized or not), a cart and any other wheeled conveyance;

"vessel" includes a ship, hovercraft, boat, ferry, raft, yacht, canoe or pontoon that is used as a conveyance in or on water, whether or not it is self-propelled;

"written" and "in writing" mean any mode of communicating information in a retrievable form, including electronically (as to which see section 104(5)).

(2) The Minister, on the advice of the Authority, may by order declare any article, substance goods or thing to be a regulated article for the purposes of this Promulgation.

*Application of the Promulgation*

3.—(1) This Promulgation applies to every person in the Fiji Islands**,** irrespective of the person s nationality or citizenship**.**

(2) This Promulgation applies to all conveyances, containers and goods while they are in the Fiji Islands, including vessels and aircraft owned or operated by the government of a foreign State;

(3) This Promulgation applies to persons, conveyances, containers and goods outside the Fiji Islands to the extent needed for its effective enforcement.

*Promulgation binds the State*

4. This Promulgation binds the State, including every Government department and statutory authority and every person in the employment of the Government.

*Responsibility for the Promulgation*

5.—(1) The Minister is responsible to the Cabinet for the implementation of this Promulgation.

(2) The Board is responsible to the Minister for the performance of the functions of the Authority set out in section 9.

*Powers of the Minister*

6. The Minister may—

*(a)* in accordance with section 9 and Schedule 2, call for reports from the Authority on any matter pertaining to this Promulgation or the functions of the Authority;

*(b)* in accordance with section 12, give directions in writing to the Authority concerning administrative action needed to implement this Promulgation and to achieve the functions of the Authority;

*(c)* in accordance with section 13, delegate any of the Minister s functions, powers and duties under this Promulgation to the Authority or a named biosecurity officer, other than any legislative or appellate function or this power to delegate.

*Relationship with other written laws*

7.—(1) This Promulgation is in addition to and does not derogate from any other Law. In particular, but without limiting this rule—

*(a)* the notification requirements in section 22 relating to human health do not displace any other statutory requirement relating to such notification;

*(b)* the provisions of Part 4 relating to biosecurity port quarantine of vessels and aircraft do not displace any other provisions relating to quarantine of vessels and aircraft;

*(c)* the requirements relating to imports and exports in Parts 5 and 6 do not displace any other statutory requirements relating to imports and exports, trade in endangered species, biosafety, biodiversity or environmental Laws generally.

(2) To the extent of any inconsistency between this Promulgation and any other written law, every other written law must so far as possible be construed so as to fulfil the purpose of this Promulgation.

## PART 2 — THE BIOSECURITY AUTHORITY OF THE FIJI ISLANDS

*Establishment of the Biosecurity Authority of the Fiji Islands*

8.—(1) This section establishes the Biosecurity Authority of the Fiji Islands as a body corporate with perpetual succession and a common seal, with power to—

*(a)* sue and be sued in its corporate name;

*(b)* acquire, hold and dispose of property; and

*(c)* do or perform such other acts or things as bodies corporate may by law do and perform.

(2) The affairs of the Authority are conducted by the Board as the governing and executive body of the Authority. The Board has the capacity to perform the functions and powers of the Authority under this Promulgation or any other written law.

(3) The Board consists of—

*(a)* a Chairperson and 5 other members appointed by the Public Enterprise Minister, in consultation with the Minister and the Minister of Finance, and with the endorsement of the Prime Minister;

*(b)* the person for the time being holding the office of CEO, or his or her nominee *ex officio,* with no voting rights.

(4) An appointed member of the Board must have experience in either management, commerce, public administration, quarantine, health or legal matters.

(5) Before appointing a person as a member, the Public Enterprise Minister must have regard to any potential conflicts of interest the person may have.

(6) Appointments under this section must be published in the *Gazette* and do not take effect until they are so published.

(7) Members, including the CEO, must—

*(a)* seek to advance the interests of the Authority;

*(b)* comply with the obligations under the Public Enterprise Act, 1996;

*(c)* to the extent possible, and consistent with the functions of the Authority, implement any policy for the benefit and best interest of the Authority;

*(d)* not publicly disclose the deliberations of the Board unless authorised to make the disclosure, or unless it is in the public interest that the disclosure be made.

(8) The terms of membership of appointed members of the Board are as set out in Part A of Schedule 1.

(9) The procedure of the Board and of any committee of the Authority is as set out in Part B of Schedule 1. Subject to that Schedule and this section, the Board and any committee may regulate its procedure in such manner as it thinks fit, consistent with the requirements of natural justice.

*Functions and powers of the Authority*

9.—(1) The general functions of the Authority are—

*(a)* to act as agent of the State and to provide services in administering and enforcing this Promulgation and any other law relating to biosecurity matters;

*(b)* to exercise the powers and perform the duties carried out by the Quarantine and Inspection Division immediately prior to the commencement of this Promulgation;

*(c)* to advise the Government on matters relating to animal and plant quarantine and biosecurity and to liaise with appropriate Ministries and statutory bodies on such matters;

*(d)* to represent the State internationally in respect of matters relating to biosecurity; and

*(e)* to perform such other functions as the Minister may assign to the Authority.

(2) The biosecurity functions of the Authority are, to the extent of the available resources and consistently with this Promulgation—

*(a)* to protect the Fiji Islands against the entry of regulated pests and diseases affecting animals, plants, human beings and the environment;

*(b)* to carry out surveillance and monitoring of pests and diseases in the Fiji Islands and assess the status of regulated pests and diseases;

*(c)* to prevent the establishment and spread of regulated pests and diseases and the release of organisms that might adversely affect animals, plants, human beings and the environment in the Fiji Islands;

*(d)* to eradicate, contain or control the movement of regulated pests and diseases that are already present in the Fiji Islands;

*(e)* to prevent the introduction and spread of regulated pests and diseases not already present in the Fiji Islands;

*(f)* to facilitate the safe importation of animals and plants and their products, and related equipment and technology;

*(g)* to facilitate the export of animals and plants and their products in accordance with the biosecurity requirements of the receiving countries;

*(h)* to facilitate international cooperation to prevent the spread of pests and diseases affecting plants, animals, human beings and the environment.

(3) The Authority—

*(a)* has all the powers reasonably necessary or convenient for the purpose of carrying out its functions under this Promulgation and regulating its own procedure;

*(b)* must adopt commercial management practices so far as is consistent with the Authority s biosecurity functions;

*(c)* must adopt international best practice in the management and development of staff.

(4) The Authority must—

*(a)* report to the Minister and the Public Enterprise Minister as required by Schedule 2;

*(b)* produce an organisation and staffing plan as required by the Public Enterprise Act, 1996;

*(c)* provide to the Minister and the Public Enterprise Minister such other returns, accounts, and other information as either Minister may from time to time reasonably require in writing.

(5) Before performing technical functions under this Promulgation, the Authority must as appropriate obtain advice from its technical section heads.

(6) The Authority must—

*(a)* in consultation with relevant government departments and statutory authorities, and the National Disaster Management Council, devise a Biosecurity Emergency Response Plan to deal with an incursion of a regulated pest or disease in the Fiji Islands and keep the plan under review;

*(b)* produce an operations manual for the guidance of biosecurity officers in electronic or hard format or both;

*(c)* to the extent possible, publicise the requirements of this Promulgation and increase public awareness of the importance of biosecurity.

*Chief Executive Officer and the Deputy Chief Executive officer*

10.—(1) The Board must appoint a Chief Executive Officer and Deputy Chief Executive Officer on terms and conditions the Board decides.

(2) The CEO—

*(a)* is responsible to the Board for the efficient running of the Authority and the administration of this Promulgation, within the resources available to the CEO and in accordance with any policy laid down by the Board;

*(b)* must perform any other functions relating to this Promulgation that the Board by directions in writing confers on the CEO from time to time;

*(c)* must report to the Board as required by the Board from time to time.

(3) The Deputy CEO performs the functions of the CEO whenever the CEO is not available to do so.

(4) Before performing technical functions under this Promulgation, the CEO or Deputy CEO must as appropriate obtain advice from technical section heads.

(5) Appointments under this section must be published in the *Gazette* and do not take effect until they are so published.

*Biosecurity officers and other employees*

11.—(1) The CEO may appoint on such terms and conditions as the CEO thinks fit such employees, agents or consultants of the Authority as are necessary or expedient for performing the functions of the Authority.

(2) At the date of commencement of this Promulgation, the provisions of Part A of Schedule 3 apply to persons employed immediately before that date in the Quarantine and Inspection Division whose services are required by the Authority for the performance of its functions under this Promulgation.

(3) The CEO may exercise disciplinary control over employees of the Authority in accordance with Part B of Schedule 3.

(4) The CEO with the approval of the Board may designate any public officer or employee of a statutory authority to be a biosecurity officer for the purposes of this Promulgation for a particular purpose or at a particular location.

(5) *(a)* The powers of a biosecurity officer are as prescribed by or under this Promulgation.

*(b)* A biosecurity officer must perform such duties, not inconsistent with this Promulgation, as are assigned to the officer by the CEO.

*(c)* The CEO may limit the functions to be performed by a biosecurity officer to those within the officer's technical sphere of competence;

*(d)* The functions assigned to an officer designated under subsection (4) must be consistent with the designation under that subsection.

(6) The CEO must provide every person designated as a biosecurity officer with a suitable form of identification as such officer.

(7) A person who—

*(a)* upon the termination of his or her appointment as a biosecurity officer fails to surrender up any identification issued under subsection (8) within a specified period; or

*(b)* copies, forges or alters a form of identification issued under subsection (7) without the written authority of the Authority, commits an offence.

(8) A person who is to perform duties as a biosecurity officer under this Promulgation must be given adequate training in biosecurity control measures and in the provisions of this Promulgation before embarking on those duties.

*Directions*

12.—(1) The Board may give written directions to the CEO as to the performance of the functions of the CEO, but may not give directions to the CEO except after receiving appropriate technical advice.

(2) The CEO may give written directions to biosecurity officers as to the manner in which their functions are to be performed, consistent with this Promulgation and the regulations and any specifications.

*Delegation of functions*

13.—(1) The Minister may in writing delegate any of the Minister s functions under this Promulgation to the Board or a named biosecurity officer, other than any legislative or appellate function or this power to delegate.

(2) The Board may, by writing under the hand of the Chairperson, delegate to the CEO, a Board member or a committee any of the Authority's functions under this Promulgation, other than—

*(a)* the power to borrow money, raise loans, give loans or advances or subscribe to or underwrite the issue of stocks or debentures of any business enterprise;

*(b)* the power to make regulations under section 106;

*(c)* this power of delegation.

(3) A delegation under subsection (2) may be to a specified person or committee or to the holder for the time being of a specified office or to the holders of offices of a specified class.

(4) The Chairperson may authorise in writing any other member of the Board to exercise any power or perform any function conferred on the Chairperson by or under this Promulgation.

(5) Subject to subsection (6), the CEO may in writing delegate—

*(a)* to the Deputy CEO, any of the functions of the CEO, including functions delegated by the Authority under subsection (2);

*(b)* to any suitably qualified biosecurity officer any of the biosecurity functions of the CEO except the power to make specifications.

(6) The CEO may not delegate any legislative, judicial or appellate function, the power of giving directions under section 12, or the power of delegation under this section, except to the Deputy CEO.

(7) A delegation under this section may be made subject to such restrictions and conditions as the delegator thinks fit, and may be made either generally or in relation to any particular case or class of cases.

(8) A person or committee purporting to perform any function by virtue of a delegation under this section must, when required to do so, produce evidence of the authority to perform the function.

*Financial provisions*

14.—(1) The assets of the Authority at the commencement of this Promulgation are the assets of the Quarantine and Inspection Division at that date, which are transferred to the Authority in accordance with Part A of

dule 4.

(2) The Minister may request Cabinet to provide finance for implementation of this Promulgation in addition to an annual appropriation.

(3) If—

*(a)* there is an incursion of a regulated pest, disease or organism into the Fiji Islands that could threaten the livelihood and environment of the country or any part of it; and

*(b)* a response is immediately required, whether by way of the declaration of a biosecurity emergency area or otherwise,

the Cabinet may approve the payment from the Consolidated Fund of such sum as it may consider to be reasonably required to deal with the incursion.

(4) The funds of the Authority consist of—

*(a)* money appropriated by the Cabinet;

*(b)* money paid to the Authority for services rendered;

*(c)* money paid to the Authority by way of grants;

*(d)* money derived from the disposal, lease or hire of, or other dealing with, any property vested in or acquired by the Authority;

*(e)* money borrowed by the Authority in accordance with this Promulgation;

*(f)* income from investments by the Authority made under this Promulgation;

*(g)* fees or other charges imposed by the Authority under this Promulgation;

*(h)* other money which is payable to the Authority in respect of any matter incidental to its functions and powers.

(5) The assets and funds of the Authority are to be dealt with in accordance with Part B of Schedule 4.

*Fines, fees and charges*

15.—(1) Fines payable under this Promulgation are to be paid to the Authority and dealt with in accordance with Part B of Schedule 4.

(2) The Authority may prescribe fees and charges payable for the services provided by the Authority under this Promulgation.

(3) Fees and charges payable under this Promulgation are to be paid to the Authority and dealt with in accordance with Part B of Schedule 4.

(4) If a fee or charge payable under this Promulgation is not paid –

*(a)* if the service for which the fee or charge is payable has not been provided, it may be withheld until the fee is paid;

*(b)* if the service has been provided, the fee or charge may be recovered as a debt owing to the Authority;

*(c)* if the fee or charge is in respect of an item in quarantine, the item may be sold once it has cleared quarantine, or otherwise be treated as abandoned goods.

## PART 3 — BIOSECURITY BORDER CONTROL

*Regulated pests and diseases*

16.—(1) The Minister may by order declare the pests or diseases—

*(a)* the importation of which is prohibited for all purposes;

*(b)* the importation of which is permitted subject to conditions specified by the Authority under section 34;

*(c)* which are under official control.

(2) A person who imports or attempts to import a pest or disease which is prohibited under subsection (1)*(a)* commits an offence.

(3) A person who imports or attempts to import a pest or disease which is regulated under subsection (1)*(b)* in breach of the conditions of import commits an offence.

(4) Before making an order under this section, the Minister must obtain—

*(a)* a pest or disease risk analysis;

*(b)* the advice of the Authority.

*Prohibited imports*

17.—(1) The Minister may by order prohibit the importation of—

*(a)* particular regulated articles from all countries; or

*(b)* particular regulated articles from one or more particular countries of origin,

(in this Promulgation referred to as "import prohibited articles") if the importation would present an unacceptable biosecurity risk to the Fiji Islands.

(2) An order under this section in respect of an article –

*(a)* may be made at any time before biosecurity import clearance is granted in respect of the article;

*(b)* continues in force until the prohibition is revoked or varied, but must be reviewed every 12 months.

(3) In making a decision under this section, the Minister—

*(a)* must have regard to the international obligations of the Fiji Islands in respect of biosecurity;

*(b)* may apply the precautionary principle.

(4) Before making an order under this section the Minister must obtain –

*(a)* a pest or disease risk analysis in relation to the article;

*(b)* the advice of the Authority.

(5) If a person imports or attempts to import a prohibited article –

*(a)* the person commits an offence;

*(b)* biosecurity import clearance under section 33 will be refused for the article.

(6) A person who without lawful excuse owns or is in possession of any prohibited article commits an offence.

*Biosecurity points of entry and departure*

18.—(1) The Minister may by order designate as biosecurity points of entry the seaports and airports at which regulated articles may enter the Fiji Islands.

(2) Subject to subsection (8), a master or captain who causes or permits an incoming vessel or aircraft to berth or land except at a seaport or airport that is a biosecurity point of entry commits an offence.

(3) A person who imports, or attempts to import, a regulated article or consignment except at a biosecurity point of entry commits an offence.

(4) The Minister may by order designate as biosecurity points of departure the seaports and airports at which regulated articles may be exported.

(5) A master or captain who causes or permits a vessel or aircraft to leave the Fiji Islands except from a seaport or airport that is a biosecurity point of departure commits an offence.

(6) A person who exports, or attempts to export, a regulated article or consignment except at a biosecurity point of departure commits an offence.

(7) A designation of a biosecurity point of entry and departure may be limited to particular types of vessels, aircraft or articles or to arrivals from or exports to particular countries.

(8) A vessel or aircraft may berth or land elsewhere than at a biosecurity point of entry—

*(a)* if constrained by adverse weather, mechanical failure or superior force; or

*(b)* if so directed or permitted by the Authority or a biosecurity officer.

(9) In the circumstances mentioned in subsection (8), the place where the vessel has berthed or the aircraft has landed is deemed to be a biosecurity point of entry for the purposes of this Promulgation, once the Authority has been notified of the berthing or landing.

(10) Before making an order under subsection (1) or (4) the Minister must obtain the advice of the Authority and consult, as the case may be, the officers or authorities responsible for the movement of vessels and aircraft in the Fiji Islands.

*Designation of biosecurity holding areas*

19. (1) The Minister in consultation with the Minister responsible for Sea Port Management may by order designate—

*(a)* any territorial waters or any part of a seaport as a biosecurity port holding area for vessels;

*(b)* any part of an airport as a biosecurity port holding area for aircraft.

(2) A biosecurity port holding area is one where incoming conveyances may be held for biosecurity inspection pending biosecurity landing clearance or other disposition under this Promulgation.

(3) The Minister may by order designate any area of land at or adjacent to a seaport or airport as a biosecurity goods holding area for incoming or outgoing containers and goods.

(4) A biosecurity goods holding area is one where incoming or outgoing containers or goods may be held for biosecurity inspection pending biosecurity clearance or other disposition under this Promulgation.

(5) The Minister may designate any part of a mail exchange as a biosecurity postal holding area for incoming or outgoing postal items.

(6) A biosecurity postal holding area is one where incoming or outgoing postal items may be held for biosecurity inspection pending biosecurity clearance or other disposition under this Promulgation.

(7) Before making an order under subsection (1), (3) or (5) the Minister must obtain the advice of the Authority and consult, as the case may be, the officers or authorities responsible for the movement of vessel, aircraft and postal items in the Fiji Islands.

*Management of biosecurity holding areas*

20.—(1) Section 48(2) and (3) apply to biosecurity holding areas as they apply to biosecurity quarantine stations.

(2) No person, other than the person in charge of the area or a biosecurity officer acting in the course of duty, may enter a biosecurity holding area without the written permission of the Authority, or the permission of the person in charge of the area or of a biosecurity officer.

(3) A biosecurity officer may, in order to reduce a biosecurity threat, lock, seal or otherwise prevent entry to and exit from a biosecurity holding area or any building in it.

(4) A person who—

*(a)* enters a biosecurity holding area without permission given under subsection (2); or

*(b)* damages, interferes with or in any way reduces the effectiveness of measures taken to secure a biosecurity holding area, or any regulated article or other item in the area, commits an offence.

(5) The Authority may issue written directions to the person in charge of a biosecurity holding area as to the management of the area.

(6) A person who removes or attempts to remove from a biosecurity holding area any regulated article without obtaining biosecurity clearance in respect of it, unless for the purpose of biosecurity measures being applied to the article in accordance with this Promulgation, commits an offence.

*Biosecurity clearance agents*

21.—(1) A person who proposes to import or export regulated articles through a seaport or airport and who will not be present when biosecurity inspection is to take place must—

*(a)* in writing appoint a person resident in the Fiji Islands as a biosecurity clearance agent for the purposes of this Promulgation; and

*(b)* notify the Authority in writing of the appointment before the agent performs any agency functions.

(2) A biosecurity clearance agent appointed under subsection (1) ceases to be an agent for the purposes of this Promulgation if the Authority notifies the importer or exporter in writing that, in the opinion of the Authority, the agent's conduct in the performance of functions under this Promulgation renders the agent unacceptable for purposes of this Promulgation.

(3) Notice under subsection (2) must be given in sufficient time to allow the importer or exporter to appoint another agent.

(4) A biosecurity clearance agent who performs or purports to perform any functions of an importer or exporter under this Promulgation is liable to the same extent as the importer or exporter for any act or omission which amounts to an offence or which creates any legal obligation under this Promulgation.

(5) If a person referred to in subsection (1) fails to comply with that subsection, biosecurity clearance will not be granted for any regulated article or consignment which the person seeks to import or export.

## PART 4 — VESSELS AND AIRCRAFTS

*Biosecurity arrival declaration*

22.—(1) The master or captain of every vessel or aircraft destined for the Fiji Islands must make to the Authority a biosecurity arrival declaration stating—

*(a)* the destination seaport or airport in the Fiji Islands and the estimated time of arrival of the vessel or aircraft;

*(b)* its immediately preceding port or place of call;

*(c)* the proposed itinerary of the vessel or aircraft until it leaves the Fiji Islands;

*(d)* the nature and country of origin of its cargo;

*(e)* the number of passengers and crew;

*(f)* the presence of any live animal or live plant on the vessel or aircraft;

*(g)* the nature of any illness or malady affecting any live animal, plant, crew member, passenger or other individual on board the vessel or aircraft; and

*(h)* any other matter relevant to facilitating biosecurity landing clearance of the vessel or aircraft that is specified by the Authority.

(2) The declaration required by subsection (1)—

*(a)* must be made not less than 24 hours in the case of a vessel, or 60 minutes in the case of an aircraft, before the estimated time of arrival;

*(b)* may be made by electronic means, in accordance with directions of the Authority issued from time to time;

*(c)* may be made through a biosecurity clearance agent;

*(d)* may be made in conjunction with or as part of a declaration made for customs or other border control purposes.

(3) A master or captain who fails to make a biosecurity arrival declaration, either directly or through a biosecurity clearance agent, commits an offence.

*Biosecurity landing clearance*

23.—(1) The master or captain of every incoming vessel or aircraft must—

*(a)* take the vessel or aircraft directly to a biosecurity port holding area as directed by a biosecurity officer;

*(b)* permit a biosecurity officer to board and search the vessel or aircraft in accordance with section 55(1);

*(c)* provide to the officer the log, cargo manifest, bill of lading, stores list, passenger list, crew list and any other document that is on or in and relates to the vessel or aircraft and that the officer reasonably requests for the purposes of this Promulgation;

*(d)* complete an incoming conveyance biosecurity certificate, in the form specified or approved by the Authority, certifying that all garbage, live animals, meat or animal products and plants or plant material on board the vessel or aircraft will be lawfully disposed of.

(2) A biosecurity officer may grant biosecurity landing clearance to the vessel or aircraft, after inspecting relevant documents and conducting any necessary search of an incoming vessel or aircraft, and if satisfied—

*(a)* that the vessel or aircraft does not have on board any regulated article that might pose a biosecurity threat to the Fiji Islands; and

*(b)* that the prescribed fee, if any, has been paid.

(3) Biosecurity landing clearance means that a vessel or aircraft may land crew members and any cargo or passengers on board, but the crew and any cargo or passengers remain subject to biosecurity control under this Promulgation.

(4) Biosecurity landing clearance must be refused if a biosecurity officer orders the vessel or aircraft into port quarantine pursuant to section 24(2).

(5) A master or captain who contravenes a provision of subsection (1) commits an offence.

(6) A master or captain who lands any crew, cargo or passengers from a vessel or aircraft without biosecurity landing clearance, except with the permission of a biosecurity officer, commits an offence.

(7) A crew member or passenger who lands from a vessel or aircraft before it has received bioecurity landing clearance, except with the permission of a biosecurity officer, commits an offence.

(8) Biosecurity landing clearance of a vessel or aircraft may be granted unconditionally, or conditioned on entry into a bond to the Authority, in the form specified or approved by the Authority, by the master of the vessel or captain of the aircraft, for compliance with any requirements imposed pursuant to this Promulgation in respect of the vessel or aircraft or cargo.

*Biosecurity port quarantine of vessels and aircrafts*

24.—(1) The Minister may by order designate—

*(a)* any territorial waters or any part of a seaport as a biosecurity port quarantine area for vessels;

*(b)* any part of an airport as a biosecurity port quarantine area for aircraft.

(2) Before making an order under subsection (1) the Minister must obtain the advice of the Authority and consult, as the case may be, the officers or authorities responsible for the movement of vessels and aircraft in the Fiji Islands.

(3) If a biosecurity officer reasonably suspects that an incoming vessel or aircraft is—

*(a)* infected or infested with a regulated pest or disease; or

*(b)* carrying any regulated article which might pose a biosecurity threat to the Fiji Islands,

the officer may order the vessel or aircraft into biosecurity port quarantine.

(4) If a vessel or aircraft is ordered into biosecurity port quarantine under subsection (2), a biosecurity officer may—

*(a)* order the master or captain to remove the vessel or aircraft to quarantine in a biosecurity port quarantine area; or

*(b)* if necessary (because the master or captain refuses to obey the order, or because of the nature of the biosecurity threat) arrange for the vessel or aircraft to be removed to the biosecurity port quarantine area.

(5) The cost of removal of a vessel or aircraft to biosecurity port quarantine is to be borne by the owner or charterer, and no compensation is payable for any loss or destruction or consequential loss caused as a result of any such removal, unless negligence or malice is proved.

(6) The owner or charterer and master or captain must each be given written notice stating the reasons for an order under this section in respect of the vessel or aircraft and, if it was removed under subsection (3), the whereabouts of the vessel or aircraft.

(7) If the Authority reasonably believes that a vessel or aircraft poses a serious biosecurity threat to the Fiji Islands which cannot adequately be dealt with by appropriate biosecurity measures, the Authority may in writing direct the vessel or aircraft to leave the waters of the Fiji Islands.

(8) Before issuing a direction under this section, the Authority must consult, as the case may be, the officers or authorities responsible for the movement of vessels or aircraft in the Fiji Islands.

*Management of biosecurity port quarantine areas*

25.—(1) No person, other than the person in charge of the area or a biosecurity officer acting in the course of duty, may enter a biosecurity port quarantine area without the written permission of the Authority or of the person in charge of the area.

(2) A person who—

*(a)* enters a biosecurity port quarantine area without permission; or

*(b)* damages, interferes with or in any way reduces the effectiveness of measures taken to secure a biosecurity port quarantine area, or any regulated article or other item in the area, commits an offence.

(3) The Authority may issue written instructions to the person in charge of a biosecurity port quarantine area as to the management of the area.

(4) A biosecurity officer may affix a notice at any biosecurity port quarantine area, and on any vessel or aircraft held in the area, stating the conditions and duration of quarantine and other information relating to the area or the item as specified by the Authority.

(5) A person who removes a notice affixed under subsection (4) without lawful authority commits an offence.

*Conduct of vessels and aircrafts in biosecurity port quarantine*

26.—(1) The Authority may give written directions to the master of a vessel or captain of an aircraft in biosecurity port quarantine—

*(a)* as to the movement of the vessel or aircraft while it is in quarantine;

*(b)* as to the movement of passengers, crew and cargo while the vessel or aircraft is in quarantine;

*(c)* as to any treatment or other biosecurity measure that must be applied to the vessel or aircraft.

(2) The cost of keeping a vessel or aircraft in biosecurity port quarantine and of any treatment or other measures that must be applied to it, is to be borne by the owner or charterer

(3) No compensation is payable for any loss or destruction or consequential loss caused by a vessel or aircraft being detained in quarantine, unless negligence or malice is proved.

(4) A master or captain who fails to take all reasonable steps to ensure that the vessel or aircraft and its cargo, crew and passengers conform to directions given under subsection (1) commits an offence.

*Biosecurity port quarantine clearance of vessels and aircrafts*

27. —(1) If satisfied—

*(a)* that a vessel or aircraft in biosecurity port quarantine is substantially free from regulated pests and diseases;

*(b)* that any potential biosecurity risk from ships, stores and other regulated articles on the vessel or aircraft is suitably contained; and

*(c)* that the prescribed fee, if any, has been paid,

a biosecurity officer may grant biosecurity port quarantine clearance for the vessel or aircraft to unload passengers and cargo.

(2) Biosecurity port quarantine clearance of a vessel or aircraft may be granted unconditionally, or conditioned on entry into a bond to the Authority, in the form specified or approved by the Authority, by the master of the vessel or captain of the aircraft, for compliance with any requirements imposed pursuant to this Promulgation in respect of the vessel or aircraft or cargo.

(3) Biosecurity port quarantine clearance of a vessel or aircraft has the same effect as biosecurity landing clearance granted under section 23.

*Outgoing vessels and aircrafts*

28.—(1) If a biosecurity officer has reason to believe that there is on board an outgoing vessel or aircraft any regulated article that requires biosecurity export clearance and that has not been cleared, the officer may—

*(a)* board and search the vessel or aircraft in accordance with section 55(1);

*(b)* request the master or captain to produce for inspection the cargo manifest, bill of lading, stores list, passenger list, crew list and any other document that is on or in and relates to the vessel or aircraft and that the officer reasonably requires for the purposes of this Promulgation;

*(c)* direct the master or captain not to move the vessel or aircraft unless permitted by the officer, and then only as directed by the officer;

*(d)* direct the vessel or aircraft to be subjected to any treatment or other biosecurity measure that is prescribed or specified;

*(e)* give to the master or captain any other lawful direction that is reasonably required to protect the destination country from a biosecurity threat posed by the vessel or aircraft.

(2) A master or captain who—

*(a)* refuses to permit a search pursuant to subsection (1)(a); or

*(b)* fails to comply with a request or direction given under subsection (1)(b) to (e), commits an offence.

*Environmental obligations of masters and captains*

29.—(1) The master of every incoming vessel must, while the vessel is in the Fiji Islands—

*(a)* take all necessary steps to prevent any animal on board the vessel from making contact with any animal on shore unless permitted by a biosecurity officer, and then only as directed by the officer;

*(b)* seal all hatches and holds and enclosed cargo areas during the hours of darkness, except as needed for the working of the vessel or its cargo.

(2) The master of every incoming vessel must take all reasonable steps to ensure that—

*(a)* no garbage containing any animal, plant, animal product or plant product;

*(b)* no bilge water or ballast water, and

*(c)* no sewage or foul wastewater,

is discharged from the vessel into the sea while the vessel is in the Fiji Islands.

(3) The master of every incoming vessel and captain of every incoming aircraft must, while the vessel or aircraft is in the Fiji Islands, take all reasonable steps to ensure that—

*(a)* all garbage generated on the vessel or aircraft is placed in a suitable leak-proof container, with a lid, and the container is securely fastened at all times and kept within the vessel or aircraft;

*(b)* garbage is not disposed of in the sea, and is only removed from the vessel or aircraft under and in accordance with the directions of a biosecurity officer.

(4) The master of every incoming vessel and captain of every incoming aircraft must take all reasonable steps to ensure that no ships, stores are removed from the vessel or aircraft while it is in the Fiji Islands, except under and, in accordance with the directions of a biosecurity officer.

(5) A biosecurity officer may lock or seal the stores of any incoming vessel or aircraft while it is in the Fiji Islands.

(6) The cost of disposal of garbage under this section is to be borne by the owner or charterer of the vessel or aircraft.

(7) A master who contravenes subsection (1)(b), fails to take all reasonable steps as required by subsection (1) *(a)*, (2), (3) or (4) or fails to obey a direction of a biosecurity officer given under any of those subsections commits an offence.

(8) A captain who fails to take all reasonable steps as required by subsection (3) or (4) or fails to obey a direction of a biosecurity officer given under either of those subsections commits an offence.

(9) An incoming vessel must comply with any de-ratting requirements prescribed by regulations.

*Passengers and crew members*

30.—(1) Subject to subsections (2) and (3), every passenger or crew member who arrives in the Fiji Islands on board a vessel or aircraft must make to a biosecurity officer a passenger arrival biosecurity declaration.

(2) The passenger arrival biosecurity declaration must be in the form specified or approved by the Authority and contain all required particulars relating to the person and any baggage that accompanies the person.

(3) A passenger or crew member does not need to declare -

*(a)* articles of clothing worn on the body;

*(b)* articles visibly attached or connected to the body or clothing; or

*(c)* suitcases and other visible containers of personal baggage,

unless a biosecurity officer so requests because of the biosecurity risk posed by the item, and in the absence of any such request, the article or container is deemed to have biosecurity entry clearance.

(4) A single declaration under subsection (1) may be made by a person in respect of the person and the person's spouse and any member of the family aged 16 years or less travelling on the same vessel or aircraft.

(5) When a declaration is tendered under this section, a biosecurity officer may—

*(a)* question the passenger or crew member;

*(b)* inspect the baggage to which it relates.

*(c)* if necessary, question a spouse or family member included on the declaration.

(6) After taking the steps in subsection (5), a biosecurity officer may either grant biosecurity entry clearance of the persons and baggage to which the declaration relates, or—

*(a)* detain the passenger or crew member for further questioning and search;

*(b)* detain the baggage and other articles in the possession of the passenger or crew member for further inspection and application of other biosecurity measures as the officer considers appropriate.

(7) An arriving passenger or crew member who fails –

*(a)* to make a declaration as required by subsection (1);

*(b)* to submit baggage for inspection when so directed under subsection (5), commits an offence.

(8) Every passenger or crew member departing from the Fiji Islands must—

*(a)* submit for inspection on request by a biosecurity officer any regulated article on the person or in the person's baggage;

*(b)* permit the officer to search the person's baggage.

(9) A departing passenger or crew member who fails to comply with subsection (8) commits an offence.

(10) Section 65 applies to the questioning, detention and searching of persons and baggage under this section.

## PART 5 — BIOSECURITY IMPORT PROCEDURES

*Biosecurity entry inspection of incoming articles*

31.—(1) Every incoming article or consignment of articles is liable to biosecurity entry inspection by a biosecurity officer at the biosecurity point of entry to ascertain whether it is or includes a regulated article.

(2) If an importer of goods fails to make the goods available for biosecurity entry inspection at the biosecurity point of entry at the request of a biosecurity officer –

*(a)* the importer commits an offence; and

*(b)* the goods may be reconsigned or destroyed as if they were a regulated article for which biosecurity entry clearance had been refused.

(3) If, after inspecting an incoming article or consignment, a biosecurity officer is satisfied -

*(a)* that it is or includes a regulated article - the provisions of this Part apply to it;

*(b)* that it is not or does not include a regulated article – the article or consignment may be released from the biosecurity point of entry upon payment of the prescribed fee, if any.

(4) If an incoming article or consignment is not inspected under this section, a biosecurity officer is deemed to be satisfied that it is not or does not include a regulated article, and subsection (3)(b) applies to it.

(5) Section 57 applies to an inspection under this section.

(6) Subject to section 101(Appeals), the actual or deemed opinion of a biosecurity officer under this section as to whether an article or consignment is or includes a regulated article is conclusive for the purposes of this Promulgation.

(7) This section does not apply in respect of baggage accompanying passengers or crew members, but section 30 applies to such baggage.

*Biosecurity import clearance of regulated articles*

32.—(1) Every incoming article or consignment of regulated articles—

*(a)* is liable to biosecurity import clearance inspection by a biosecurity officer;

*(b)* for that purpose must be taken to or retained in a biosecurity holding area for inspection.

(2) An application for biosecurity import clearance of a regulated article or consignment must—

*(a)* be made to a biosecurity officer in the manner specified or approved by the Authority;

*(b)* be accompanied by the prescribed fee, if any;.

*(c)* state the country of origin of the article or consignment;

*(d)* state the nature and quantity of the article or consignment;

*(e)* attach any sanitary or phytosanitary certificate issued by the country of origin in relation to the article or consignment;

*(f)* attach any biosecurity import permit relating to the document;

*(g)* attach documentation relating to any other biosecurity measures specified under section 34(1) in relation to the article or consignment.

(3) The importer of a regulated article or consignment must on the request of a biosecurity officer—

*(a)* if the article or consignment is in a container - open the container or enable the officer to do so;

*(b)* allow the officer to inspect the article or consignment in accordance with section 57;

*(c)* allow the officer to take samples and conduct tests in accordance with Part 8 to enable the officer to determine whether biosecurity import clearance should be granted;

*(d)* if the article or consignment requires biosecurity measures to be applied to it - submit the article or consignment to such measures.

(4) The cost of taking an article to a biosecurity holding area, and of keeping it there, is to be borne by the importer of the article, and no compensation is payable for any loss or destruction or consequential loss caused as a result of the taking or keeping, unless negligence or malice is proved.

(5) If the importer of a regulated article or consignment fails to comply with any of the requirements of subsection (3)—

*(a)* the person commits an offence; and

*(b)* a biosecurity officer may refuse to grant import clearance for the article or consignment, and may order the article or consignment to be reconsigned or destroyed.

(6) This section does not apply to passengers or crew members, but section 30 applies to such persons.

*Grant and refusal of biosecurity import clearance*

33.—(1) Before granting biosecurity import clearance of an article or consignment, a biosecurity officer must be satisfied that the article meets the biosecurity import requirements in relation to it, that is to say –

*(a)* if a biosecurity import permit is required - it has been obtained in respect of the article or consignment and the conditions of the permit have been complied with;

*(b)* if a sanitary or phytosanitary certificate is required for an article - the relevant certificate has been issued by the country of origin, and any requirement in it complied with;

*(c)* if any other biosecurity measures are specified under section 34(1)(c) - they have been applied to or in respect of the article or consignment.

(2) If satisfied in respect of an article or consignment—

*(a)* of the matters mentioned in subsection (1); and

*(b)* that all prescribed fees and charges relating to the article or consignment have been paid,

a biosecurity officer must grant biosecurity import clearance for the article or consignment.

(3) If the biosecurity risk presented by an incoming regulated article or consignment so requires, a biosecurity officer may refuse to grant biosecurity import clearance for the article or consignment, or may require additional biosecurity measures to be applied to it, even if the article or consignment meets the biosecurity import specifications in relation to it.

(4) Biosecurity import clearance may be made conditional on the article performing biosecurity quarantine if—

*(a)* quarantine is a biosecurity import requirement for the article; or

*(b)* during biosecurity entry inspection or biosecurity import clearance inspection the article is found to be, or is suspected to be, infested, infected or contaminated.

(5) Biosecurity import clearance must be refused for an incoming article which is a prohibited import.

(6) A biosecurity officer may cause any incoming article or consignment in respect of which biosecurity import clearance is refused to be reconsigned or destroyed, but the importer must be given reasonable time to make arrangements for reconsignment of the article or consignment before it is destroyed.

(7) No compensation is payable in respect of a refusal in good faith to grant biosecurity import clearance under this section.

*Biosecurity import specifications*

34.—(1) The Authority may specify in respect of incoming regulated articles—

*(a)* whether a sanitary or phytosanitary certificate from the biosecurity authority in the country of origin is required for an article and if so the matters that must be certified;

*(b)* whether a biosecurity import permit must be obtained for the article and if so the conditions to be attached to the permit;

*(c)* what biosecurity measures, if any, must be applied to the article on arrival in the Fiji Islands before biosecurity import clearance can be granted.

(2) Specifications under subsection (1) –

*(a)* may be different for different types and quantities of regulated article;

*(b)* may be by reference to the country or area of origin of the article;

*(c)* must only be those reasonably necessary to reduce or eliminate the biosecurity risk to the Fiji Islands presented by the article.

(3) In determining specifications under subsection (1), the Authority—

*(a)* must make a biosecurity risk assessment;

*(b)* must have regard to the requirements of the SPS Agreement and other international standards relating to biosecurity matters;

*(c)* must have regard to the resources available for biosecurity control;

*(d)* may apply the precautionary principle.

(4) The biosecurity risk assessment needed for making a specification under this section –

*(a)* may be performed by any qualified person (other than the importer) at the request of the Authority;

*(b)* is performed at the importer s expense.

(5) Specifications made under subsection (1) in respect of an article may be changed at any time before biosecurity import clearance is obtained in respect of the article if the biosecurity risk presented by the article or consignment changes.

(6) Notice of a change in an import specification in respect of an article should be given to intending importers as soon as practicable but no liability arises from a failure to do so.

(7) Before making or changing a specification under this section, the Authority must obtain the advice of its technical section heads.

(8) Specifications made under this section must be -

*(a)* published in the biosecurity register and at the office of the Authority; and

*(b)* made available to the public for inspection or purchase.

*Biosecurity access arrangements*

35.—(1) A person proposing to import a regulated article of a type that is not the subject of a biosecurity import specification must apply in writing to the Authority for a specification under section 34 in respect of the article.

(2) An application under subsection (1) in respect of an article must—

*(a)* be made in sufficient time before the intended importation; and

*(b)* give adequate information about the biosecurity procedures of the country of origin, the nature of the article and the proposed importation, to enable the Authority to make a biosecurity risk assessment in relation to the article.

(3) Upon receipt of an application under subsection (1), and on payment of the prescribed fee, if any, the Authority must as soon as practicable, unless the article is or becomes a prohibited import under section 17, make a specification in respect of it in accordance with section 34.

(4) Section 34(2), (3) and (4) apply to the making of a specification under this section.

*Application for a biosecurity import permit*

36.—(1) If a biosecurity import permit is required under section 34(1) in respect of a regulated article or consignment, an application for a permit must—

*(a)* be made before the article or consignment leaves the country of origin or, in the case of re-exported goods, the re-exporting country.

*(b)* be made to the Authority in the manner specified or approved by the Authority; and

*(c)* be accompanied by the prescribed fee, if any.

(2) An application for a biosecurity import permit must—

*(a)* include evidence of the country of origin of the regulated article or consignment;

*(b)* state the nature and amount of the article or consignment;

*(c)* state the expected date of arrival in the Fiji Islands; and

*(d)* give any other information the Authority reasonably requires to enable the Authority to make a biosecurity risk assessment.

(3) A decision on an application for a biosecurity import permit must be communicated to the applicant as soon as reasonably practicable after the application is received duly completed.

(4) If the decision is to refuse the permit, the applicant must be notified in writing, with brief reasons.

*Issue of a biosecurity import permit*

37.—(1) If satisfied of the matters set out in section 36(1) and (2), and on payment of the prescribed fee, if any, the Authority, or a biosecurity officer, must as soon as practicable issue a biosecurity import permit.

(2) The form of a biosecurity import permit is as specified or approved by the Authority.

(3) A biosecurity import permit may—

*(a)* be general or specific;

*(b)* relate to a single article or to a consignment of articles;

*(c)* be different for different types of regulated article and relate to different countries of origin.

(4) A general permit may relate to all imports of a type specified in the permit, or from an area specified in the permit, and may relate to continuing imports over a period specified in the permit. A specific permit will relate to a single article or consignment and may specify an expiry date.

*Revocation of a biosecurity import permit*

38.—(1) The Authority may at any time, on written notice to the holder of a biosecurity import permit, revoke the permit, or vary the conditions of the permit, if a change in the biosecurity risk to the Fiji Islands presented by the article or consignment to which the permit relates so requires.

(2) Biosecurity import clearance must be refused for an article or consignment in respect of which a biosecurity import permit is revoked, but section 34(5) applies to a revocation as it does to the change of a biosecurity specification.

(3) When a biosecurity import permit is revoked, the holder of the permit must surrender it to a biosecurity officer as soon as practicable.

(4) A person who contravenes subsection (3) commits an offence.

(5) No compensation is payable in respect of the revocation in good faith of a permit under this section.

*Exemption from biosecurity import requirements*

39.—(1) The Authority may in writing exempt any regulated article, class of regulated articles or consignment of regulated articles—

*(a)* from any or all of the biosecurity import specifications that would otherwise apply to the article or class of articles;

*(b)* from a requirement for a biosecurity import permit that would otherwise apply to the article or consignment.

(2) An exemption under subsection (1) applies only to a single importation.

(3) An exemption under subsection (1) may specify the conditions on which the article, class of articles or consignment is exempt. If the conditions are not met the exemption ceases to apply

(4) The Authority may only grant an exemption under subsection (1) upon receipt of advice from its technical section heads, and if satisfied that the biosecurity risk to the Fiji Islands is not increased as a result.

(5) A request for exemption under this section must be—

*(a)* made in writing to the Authority;

*(b)* accompanied by the prescribed fee, if any, and the specified documents;

*(c)* made in sufficient time to allow the Authority to give due consideration to the request.

(6) Articles exempted from biosecurity import specifications or the requirement for an import permit under this section are not exempt from the requirement for biosecurity import clearance.

*Articles and passengers in transit*

40.—(1) Regulated articles in transit are liable to biosecurity import control, and require biosecurity import clearance at a biosecurity holding area.

(2) The Authority or a biosecurity officer may in writing waive any requirement for a sanitary or phytosanitary certificate or biosecurity import permit that would otherwise apply to articles in transit.

(3) If a waiver is granted under subsection (2), the Authority or officer may attach conditions to the waiver.

(4) A person who—

*(a)* deals with articles to which this section applies other than by way of transit; or

*(b)* contravenes a condition specified under subsection (3) in relation to them, commits an offence.

(5) A request for a waiver under this section must be—

*(a)* made in writing to the Authority;

*(b)* accompanied by the prescribed fee, if any, and the specified documents;

*(c)* made in sufficient time to allow the Authority or a biosecurity officer to give due consideration to the request.

(6) In the case of regulated articles which accompany a crew member or passenger in transit—

*(a)* subsection (5) is deemed to have been complied with if the passenger or crew member complies with other requirements for regulated articles in transit;

*(b)* the requirement in subsection (2) for a waiver to be in writing does not apply.

(7) A biosecurity officer may at any time inspect an article in transit if the officer reasonably suspects the article might pose a biosecurity threat to the Fiji Islands or a receiving country

(8) A person in charge of an article in transit who refuses to comply with a request for inspection under subsection (7) commits an offence.

## PART 6 — BIOSECURITY EXPORT PROCEDURES

*Biosecurity export inspection of outgoing articles*

41.—(1) Every outgoing regulated article or consignment of regulated articles is liable to biosecurity export inspection at the biosecurity point of departure to enable a biosecurity officer—

*(a)* to ascertain whether it is or includes an article that requires biosecurity export clearance pursuant to section 42;

*(b)* if so,to decide whether to grant export clearance under section 46.

(2) An exporter of goods who fails to make the goods available for biosecurity export inspection at the biosecurity point of departure at the request of a biosecurity officer commits an offence.

(3) A biosecurity officer may only request to inspect an outgoing article or consignment if the officer has reasonable cause to suspect that it is or includes a regulated article that requires biosecurity export clearance pursuant to section 42.

(4) If, after inspecting an outgoing article or consignment under this section, a biosecurity officer is satisfied—

*(a)* that it is or includes an article that requires biosecurity export clearance, the provisions of this Part apply to it;

*(b)* that it is not or does not include such an article – the article or consignment may be released from the biosecurity point of departure upon payment of the prescribed fee, if any. .

(5) Section 57 applies to an inspection under this section.

(6) This section does not apply in respect of baggage accompanying passengers or crew members.

*Requirement for biosecurity export clearance*

42.—(1) An article intended for export to a receiving country that requires—

*(a)* a sanitary or phytosanitary certificate for importation into that country; or

*(b)* any biosecurity measures to be applied to it under section 44(2) before being exported to that country, must have biosecurity export clearance for export to that country.

(2) A person who exports or attempts to export an article or consignment that requires biosecurity export clearance without such clearance commits an offence.

*Issue of sanitary and phytosanitary certificates*

43.—(1) A person who wishes to obtain a sanitary or phytosanitary certificate or a certificate of origin in respect of an article in order to comply with the biosecurity certification requirements of the receiving country must—

*(a)* apply to the Authority in writing;

*(b)* pay the prescribed fee, if any;

*(c)* submit the article for inspection or other biosecurity measures as required by the receiving country.

(2) Upon receipt of an application under subsection (1), the Authority must –

*(a)* ascertain the biosecurity certification requirements of the receiving country, through the applicant or directly from the country;

*(b)* perform appropriate inspection and apply appropriate biosecurity measures to the article as required by the receiving country;

*(c)* if satisfied that the biosecurity certification requirements of the receiving country have been met, issue the appropriate certificate upon payment of the prescribed fee.

(3) A biosecurity certification requirement entered in the biosecurity register—

*(a)* if certified by or on behalf of the Authority, is conclusive evidence of the requirement for purposes of this Promulgation; but

*(b)* does not create any liability on the Government or the Authority if relied on by an exporter to the exporter s detriment.

*Biosecurity export specifications*

44.—(1) The Authority may specify in respect of outgoing animals or plants, or their products, any biosecurity measures, in addition to biosecurity certification requirements of the receiving country, that must be applied to the animal, plant or product before export.

(2) Specifications under subsection (1) may only be made if required by an international agreement to which the Fiji Islands and the receiving country are party in respect of the movement of animals, plants or animal or plant products, and must conform to any such agreement.

(3) Specifications under subsection (1) in respect of an animal or animal product may be changed at any time before biosecurity export clearance is granted, if there is a change in the relevant international obligations relating to the animal or animal product, and section 34(6) applies to any such change.

(4) Before making or changing a specification under this section, the Authority must obtain the advice of its technical section heads.

(5) Specifications made under this section must be—

*(a)* published in the biosecurity register and at the office of the Authority; and

*(b)* made available to the public for inspection or purchase.

*Application for biosecurity export clearance*

45.—(1) An application for biosecurity export clearance of an article or consignment must be made to a biosecurity officer in the manner specified or approved by the Authority and be accompanied by the prescribed fee, if any.

(2) An application for biosecurity export clearance for a regulated article or consignment must –

*(a)* be made before the regulated article or consignment arrives at a biosecurity point of departure; and

*(b)* allow sufficient time for processing of the application.

(3) An application for biosecurity export clearance for an article or consignment must—

*(a)* specify the receiving country;

*(b)* specify the nature and quantity of the article or consignment;

*(c)* attach any sanitary or phytosanitary certificate issued under section 43(2) in relation to the article or consignment;

*(d)* attach documentation relating to any other biosecurity measures required under section 44(1) in relation to animals or plants or animal or plant products.

(4) If the article or consignment requires biosecurity measures to be applied to it, the person seeking to export it must submit the article or consignment to such measures, failing which biosecurity export clearance will not be granted.

(5) If a person seeking to export an article or consignment fails to comply with any of the requirements of this section, a biosecurity officer may refuse to grant biosecurity export clearance for the article or consignment.

(6) This section does not apply to passengers or crew members, but section 28 applies to such persons.

*Grant of biosecurity export clearance*

46.—(1) Before granting biosecurity export clearance in respect of an article or consignment, a biosecurity officer must be satisfied—

*(a)* that the biosecurity certification requirements of the receiving country have been complied with;

*(b)* that any biosecurity measures specified under section 44(1) in respect of an animal or animal product have been applied;

*(c)* that the prescribed fee, if any, has been paid.

(2) If an outgoing article that requires biosecurity export clearance is found to be infected, infested or contaminated by a regulated pest or disease, biosecurity clearance will be refused in respect of it.

(3) A decision on an application for biosecurity export clearance must be communicated to the applicant as soon as reasonably practicable after the application is received duly completed.

(4) If the decision is to refuse clearance, the applicant must be notified in writing, with brief reasons.

(5) If a biosecurity officer considers it necessary to inspect any outgoing article or consignment for the purposes of this section, section 57 applies.

## PART 7 — BIOSECURITY QUARANTINE

*Biosecurity quarantine of regulated articles*

47.—(1) A biosecurity officer may, by notice in writing to the importer, order into biosecurity quarantine any incoming regulated article if—

*(a)* the article is a prohibited import and must therefore be reconsigned or destroyed;

*(b)* quarantine is a biosecurity import requirement for the article; or

*(c)* during biosecurity entry inspection or biosecurity import clearance inspection the article is found to be, or is suspected to be, infested, infected or contaminated.

(2) If an article is ordered into biosecurity quarantine under this section, a biosecurity officer may—

*(a)* in writing direct the importer to remove the article to a specified biosecurity quarantine station;

*(b)* if necessary (because the importer, exporter, owner or custodian refuses to obey the direction, or because of the nature of the biosecurity threat) arrange for the article to be removed to a biosecurity quarantine station.

(3) An importer who refuses to remove an article to biosecurity quarantine as directed under this section commits an offence.

(4) The cost of removal of an article to biosecurity quarantine is to be borne by the importer of the article, and no compensation is payable for any loss or destruction or consequential loss caused as a result of any such removal, unless negligence or malice is proved.

(5) If an article is quarantined under this section, the importer must be given written notice stating the reasons for the quarantine and, if it was removed under subsection (2)(b), the location of the article.

*Biosecurity quarantine stations*

48.—(1) The Minister, on the advice of the Authority, and after consulting other relevant Ministries, may by order designate any public or private land as a biosecurity quarantine station for animals, animal products, plants, plant products, conveyances, containers or other goods for the purposes of this Promulgation.

(2) Before designating any private land as a biosecurity quarantine station, the Minister, through the Authority, must consult the owner, and must pay compensation as agreed or as determined by a court for use of the land as a quarantine station.

(3) The Authority must ensure that every biosecurity quarantine station is provided with such buildings and facilities as are reasonably needed –

*(a)* to hold regulated articles in biosecurity quarantine;

*(b)* to prevent unauthorized persons from entering the station or removing items from the station;

*(c)* to enable the Authority to perform tests, provide treatment and apply other biosecurity measures as required by or under this Promulgation.

*Conditions of biosecurity quarantine*

49.—(1) The Authority may issue specifications as to—

*(a)* the examination, treatment, disposal or destruction of articles while in a biosecurity quarantine station or in transit to or from a quarantine station;

*(b)* the period for which different types of regulated articles must remain in a biosecurity quarantine station.

(2) The fees or charges payable for keeping items in biosecurity quarantine are as prescribed by the Authority.

(3) The cost of keeping an article in biosecurity quarantine is to be borne by the importer of the article.

(4) No compensation is payable for any loss or destruction or consequential loss caused by an item being detained in biosecurity quarantine, unless negligence or malice is proved.

*Management of biosecurity quarantine stations*

50.—(1) No person, other than the person in charge of the station or a biosecurity officer acting in the course of duty, may enter a biosecurity quarantine station without the written permission of the Authority or of the person in charge of the station.

(2) A biosecurity officer may, in order to reduce a biosecurity threat, lock, seal or otherwise prevent entry to and exit from a biosecurity quarantine station or any building in it, regardless of the ownership of the station.

(3) A person who—

*(a)* enters a biosecurity quarantine station without permission pursuant to subsection (1); or

*(b)* damages, interferes with or in any way reduces the effectiveness of measures taken to secure a biosecurity quarantine station, or any regulated article or other item in the station, commits an offence.

(4) The Authority may issue written instructions to the person in charge of a biosecurity quarantine station as to the management of the station.

*Release from biosecurity quarantine*

51.—(1) A conveyance, container or article must not be released from biosecurity quarantine except upon the authority of a biosecurity quarantine release certificate issued by a biosecurity officer.

(2) Before an article can be released from biosecurity quarantine –

*(a)* any treatment required as a condition of importation of the article must have been applied; and

*(b)* all quarantine fees must have been paid.

(3) Once subsection (2) has been complied with, the conveyance, container or article must be released from biosecurity quarantine as soon as practicable and a biosecurity release certificate issued.

(4) A person who releases an article from a biosecurity quarantine station contrary to subsection (1) commits an offence.

*Biosecurity quarantine notices*

52.—(1) A biosecurity officer may affix a notice on any biosecurity quarantine station, and on any conveyance, container or article held in biosecurity quarantine, stating the conditions and duration of quarantine and other information relating to the station or the item as specified by the Authority.

(2) A person who removes a notice affixed under subsection (1) without lawful authority commits an offence.

*No plant or animal to be at large*

53.—(1) No person may liberate or cause to be liberated from a biosecurity quarantine station, biosecurity port quarantine area, or biosecurity holding area or let go at large in the Fiji Islands any animal, plant or organism which is subject to biosecurity control under this Promulgation.

(2) A person who contravenes subsection (1) is not entitled to any compensation for loss of or damage to the animal, plant or organism occasioned by its being recaptured and confined or if necessary destroyed in accordance with Parts 8 and 9.

(3) A person who contravenes subsection (1) commits an offence and, in addition to the prescribed maximum penalty, is liable to pay the Authority the cost of recapturing and confining or if necessary destroying the animal, plant or organism.

## PART 8 — POWERS OF BIOSECURITY OFFICERS

*General rules as to exercise of powers*

54.—(1) The powers conferred by this Promulgation on biosecurity officers may be exercised only for the purpose of ascertaining whether there is a biosecurity risk presented by a conveyance, container or item and elimina or reducing the risk to an acceptable extent.

(2) A reference in this Promulgation to a biosecurity officer, when exercising powers, means a duly authorised biosecurity officer acting in the performance of his or her duties.

(3) A biosecurity officer may use only such force as is reasonably necessary when exercising a power under this Promulgation. If necessary, the officer should obtain the assistance of a police officer to effect an arrest or enter premises.

(4) Before exercising a power to enter and search premises, to search a conveyance or container or to inspect or test any article, a biosecurity officer must, if practical, request the assistance of the person in control of the premises, conveyance, container or article.

(5) Except as otherwise provided in this Promulgation, a biosecurity officer may exercise a power under this Promulgation without a warrant or other order of a magistrate, provided the action is taken in good faith for the purposes of this Promulgation.

(6) A biosecurity officer exercising powers under this Part must produce for inspection his or her identification as an officer, upon request by the person in charge of the conveyance, premises or area, or the importer, exporter, owner or custodian of the item, in respect of which the power is being exercised.

(7) Before exercising a power in a situation that involves shipping, civil aviation, human health, the environment or any other activity governed by another Law, a biosecurity officer must if practicable consult the officer or authority responsible under that Law for that activity.

(8) The powers conferred on biosecurity officers by or under this Promulgation must be exercised subject to—

*(a)* any regulations made by the Minister under this Promulgation in respect of those powers;

*(b)* any biosecurity specifications made in respect of regulated articles;

*(c)* any written directions of the Authority given under section 77;

*(d)* the provisions of—

(i) the Vienna Convention on Diplomatic Relations relating to the premises of a diplomatic mission, diplomatic bags and the personal baggage of diplomatic agents;

(ii) the Vienna Convention on Consular Relations relating to consular premises, archives and documents.

*Entry, search and seizure*

55.—(1) A biosecurity officer may—

*(a)* search an incoming vessel or aircraft at a biosecurity port holding area to ascertain whether the vessel or aircraft has on board any regulated article that might pose a biosecurity threat to the Fiji Islands;

*(b)* search an outgoing vessel or aircraft if the officer has reason to believe there are on board any uncleared articles that require export clearance;

*(c)* at any time enter and search any premises, building or area, including a biosecurity holding area, biosecurity quarantine station or biosecurity approved premises and land adjacent to a dwelling house, but not a dwelling house, in order to ascertain the presence of uncleared regulated articles that have not received biosecurity import clearance;

*(d)* at any time with the consent of the owner, enter and search a dwelling house for purposes of this Promulgation;

*(e)* at any time, on a warrant issued under subsection (2), enter and search a dwelling house for uncleared regulated articles that the officer reasonably suspects to be in it.

(2) If a magistrate is satisfied on affidavit evidence by a biosecurity officer that—

*(a)* there may be in a dwelling house uncleared regulated articles; and

*(b)* the consent of the owner or occupier to entry and search of the dwelling house cannot be obtained,

the magistrate may issue a warrant authorising the officer to enter and search the dwelling house for uncleared regulated articles.

(3) A biosecurity officer may at any time enter and search any store, warehouse, silo, pen or similar premises, or any conveyance, in which regulated articles intended for importation to or exportation from the Fiji Islands are kept.

(4) A person who keeps regulated articles in or on any premises, or in a conveyance, prior to importation or exportation of them must make the premises or conveyance available for inspection by a biosecurity officer upon request at any reasonable time.

(5) Subsections (1), (3) and (4) apply to premises and conveyances outside the Fiji Islands in respect of articles intended for importation to the Fiji Islands.

(6) A person who contravenes subsection (4) commits an offence.

(7) During a search of premises or a conveyance under this section a biosecurity officer may seize anything which—

*(a)* is an uncleared regulated article ; or

*(b)* may be used as evidence of the commission of an offence under this Promulgation.

(8) A biosecurity officer who seizes anything from a person under subsection (7) must—

*(a)* inform the person of the reason for the seizure;

*(b)* give the person a receipt for the thing seized; and

*(c)* remove the thing to a place of safekeeping and deal with it in accordance with this Promulgation.

(9) A biosecurity officer may, at the expense of the importer, submit to appropriate biosecurity measures any regulated article seized pursuant to this section.

*Inspection of documents*

56.—(1) A biosecurity officer may—

*(a)* call for and inspect documents on or in incoming or outgoing vessels and aircraft as provided in sections 23 and 28 respectively;

*(b)* open and inspect at a biosecurity point of entry any incoming document, including mail, in order to ascertain whether the document contains or relates to a regulated article;

*(c)* open and inspect at a biosecurity point of departure any outgoing document, including mail, if the officer reasonably suspects that the document contains or relates to -

(i) an uncleared regulated article that requires biosecurity export clearance; or

(ii) a regulated article that could pose a serious biosecurity threat to the country of destination of the document.

(2) The powers relating to mail in subsection (1)(b) and (c) must only be exercised in respect of personal letters if the officer reasonably suspects that a letter contains or relates to a biosecurity threat.

*Inspection of articles*

57.—(1) A biosecurity officer may at a biosecurity holding area inspect any incoming regulated article, and any conveyance, container or baggage in which the article is carried, in order to assess the biosecurity risk presented by the article, conveyance, container or baggage.

(2) A biosecurity officer may at a biosecurity point of departure inspect any article, which requires biosecurity export clearance, in order to facilitate such clearance.

(3) The powers of inspection in subsection (1) and (2) are in addition to the powers of inspection in sections 31 and 41 and any other powers of inspection in or under this Promulgation.

(4) For the purpose of exercising the powers of inspection under this Promulgation, a biosecurity officer may request an importer or exporter to unpack and/or break up a consignment, or to open a container, at the person's risk and expense.

(5) If an importer or exporter refuses to comply with a request under subsection (4)—

*(a)* the person commits an offence;

*(b)* the biosecurity officer may break up the consignment or open the container or cause it to be broken or opened;

*(c)* the cost of action under paragraph (b) is a debt owing to the Authority by the importer or exporter, as the case may be;

*(d)* no liability lies on the Government, the Authority or any biosecurity officer and no compensation is payable, for the action of breaking up or opening, unless negligence or malice is proved.

(6) When conducting an inspection under this Promulgation, a biosecurity officer may seek access to, and take photographic, electronic or other copies of any evidence, information, records and things related to the regulated article or consignment that the officer reasonably requires in order to ensure compliance with this Promulgation or to investigate a possible offence under it.

(7) Inspection of articles in transit is governed by section 40(7).

*Detention of articles*

58.—(1) If an incoming regulated article requires biosecurity measures to be taken in respect of it before biosecurity import clearance can be granted, a biosecurity officer may detain the article, and any conveyance, container or baggage in which the article is carried, for biosecurity measures to be taken.

(2) If an outgoing regulated article that requires biosecurity export clearance has not been cleared, a biosecurity officer may detain the article, and any conveyance, container or baggage in which the article is carried, until clearance or other disposition of the article under this Promulgation.

(3) An article detained under this section must be detained in a place specified by the officer, being a biosecurity holding area, biosecurity quarantine station or biosecurity approved premises.

(4) If an article is to be detained under this section, a biosecurity officer may—

*(a)* direct the importer or exporter of the article to remove it to the specified place;

*(b)* if necessary (because the importer or exporter refuses to obey the direction, or because of the nature of the biosecurity threat,) arrange for the article to be removed to the specified place.

(5) If an article is detained under this section, a biosecurity officer must give to the importer or exporter a notice in writing stating the reasons for the detention and, if it was removed under subsection (4)(b), the specified place.

(6) The cost of removal of an article to and its detention in a specified place is to be borne by the importer or exporter, and no compensation is payable for any loss or destruction or consequential loss caused as a result of any such removal or detention, unless negligence or malice is proved.

(7) The charges for detention of an article under this section are as prescribed by the Authority.

*Taking of samples*

59.—(1) A biosecurity officer may, with the consent of the importer, owner or custodian, take samples from—

*(a)* any part of an incoming vessel or aircraft that has on board regulated articles;

*(b)* any warehouse containing regulated articles intended for importation ;

*(c)* any consignment of incoming regulated articles, wherever located;

*(d)* any incoming container, baggage or thing that the officer reasonably suspects to be or include a regulated article.

(2) If an importer refuses consent under subsection (1), the biosecurity officer may require the person to provide appropriate samples.

(3) An importer who refuses either to allow samples to be taken or to provide samples, when required to do so under this section, commits an offence.

(4) A biosecurity officer may, with the consent of the person in charge of the article, take samples of any outgoing regulated article if the taking of a sample is necessary for the issue of a sanitary or phytosanitary certificate.

(5) If the person in charge of a regulated article refuses consent under subsection (4), the biosecurity officer may require the person to provide a sample, failing which the sanitary or phytosanitary certificate will not be issued.

(6) A biosecurity officer may request the importer or exporter of a consignment to unpack it or break it up to facilitate sampling, at the risk and expense of the importer or exporter

(7) When exercising powers under subsection (1) or (2), a biosecurity officer must give the importer or exporter a written notice, identifying the quantity of the sample and the place where the sample is to be analysed.

(8) In other respects, the procedure for taking and analysing samples, recording the results and disposing of the samples is as prescribed or specified.

(9) If, in the course of sampling, goods are destroyed or damaged, without negligence or malice, no compensation is payable to the importer or exporter of the goods.

(10) The importer or exporter of a regulated article from which samples are taken under subsection (1) must be notified in writing of the findings in respect of the samples as soon as reasonably practicable .

(11) The charges for taking and analysis of samples under this section are as prescribed by the Authority.

*Testing of articles*

60.—(1) A biosecurity officer may test, or cause tests to be conducted on, any incoming regulated article, in order to ascertain whether the article meets the biosecurity import requirements in respect of it

(2) Following a test of an incoming article, and on payment of the prescribed fee, if any, the article must be either released to the importer, and biosecurity import clearance granted in respect of it, or it must be treated in accordance with section 53 or reconsigned or destroyed.

(3) A biosecurity officer may test, or cause tests to be conducted on, any outgoing regulated article that requires biosecurity export clearance if such tests are a condition for importation into the receiving country

(4) Following tests on an outgoing article, biosecurity export clearance must either be granted or refused in respect of the article.

(5) Section 58(3) to (6) apply to articles detained for testing under this section.

(6) The importer or exporter of a regulated article which is tested under subsection (1) or (3) must be notified in writing of the results of the test before the article is released or otherwise disposed of.

(7) If a test conducted under subsection (1) or (3) without negligence or malice destroys or damages an animal or other article being tested, no compensation is payable to the importer of the animal or other article.

(8) The charges for testing of an article under this section are prescribed by the Authority.

*Treatment of articles*

61.—(1) If an incoming regulated article requires treatment in order to meet the biosecurity import requirements in respect of it, the article must be treated before biosecurity import clearance is granted in respect of it.

(2) If an incoming article is found to be infected, infested or contaminated by a regulated pest or disease, the article may be treated to reduce the biosecurity risk to an acceptable level, whether or not treatment is a specified requirement or a condition of an import permit.

(3) Section 58(3) to (6) apply to articles detained for treatment under this section.

(4) Once treatment has been administered to the satisfaction of the biosecurity officer, and on payment of any applicable charges, the article must, subject to subsection (4), be released to the importer and biosecurity import clearance granted in respect of it.

(5) The cost of treatment is to be borne by the importer of the item, but the importer may instead opt to have the article reconsigned or destroyed .

(6) If an importer fails to have an article which requires treatment under this section treated within a reasonable time, the biosecurity officer may require the article to be destroyed.

(7) If—

*(a)* appropriate treatment is not available in the Fiji Islands;

*(b)* in the opinion of a biosecurity officer, there would still be a biosecurity risk after treatment; or

*(c)* the importer chooses not to have the article treated, the article must be reconsigned or, if the importer chooses, or if section 62(3) applies, destroyed.

(8) Notice of action to be taken under subsection (6) or (7) must be given to the importer in writing before the action is taken, except for articles in passenger baggage which are detained for destruction in the presence of the owner or custodian.

(9) If an outgoing regulated article requires treatment as a condition of importation into the receiving country, the article must be treated at the expense of the exporter before biosecurity export clearance is granted in respect of it.

(10) If, in the course of treatment, goods are destroyed or damaged, without negligence or malice, no compensation is payable to the importer or exporter of the goods.

(11) Treatment of an article—

*(a)* should be the minimum required to remove or adequately reduce the biosecurity risk posed by the article;

*(b)* may be administered by an appropriately qualified biosecurity officer, or by any other suitably qualified person at the request of the officer or the importer.

(12) The charges for treatment of an article under this section are as prescribed by the Authority.

*Reconsignment of articles*

62.—(1) If an incoming regulated article which requires an import permit or a sanitary or phytosanitary certificate does not have the permit or certificate attached to it, a biosecurity officer may, after informing the importer, detain the article for reconsignment or destruction .

(2) An incoming article that is a prohibited import must be reconsigned or destroyed.

(3) Reconsignment is at the option and cost of the importer, but—

*(a)* reconsignment must be effected within a time specified by the officer, which must be reasonable in the circumstances;

*(b)* if the biosecurity officer considers that the biosecurity risk of reconsignment is unacceptable, the option is not available.

(4) The power to order reconsignment of an article under this section applies also to any container, crate, baggage, package or mail which carries it.

(5) If reconsignment is not effected within the time specified under subsection (3)(a), or is not acceptable, the article or consignment must be destroyed.

(6) No compensation is payable to the importer for the cost of reconsignment under this section.

*Destruction of articles*

63.—(1) If this Promulgation requires or authorizes an article to be destroyed, the destruction of the article must be in accordance with this section.

(2) If an incoming article is found to be infected, infested or contaminated by a regulated pest or disease, and—

*(a)* appropriate treatment is not available in the Fiji Islands;

*(b)* in the opinion of the Authority, there would still be a biosecurity risk after treatment; or

*(c)* the importer chooses not to have the article treated,

the article must be reconsigned or, if the importer chooses, or if section 62(3) applies, destroyed.

(3) The power of destruction of articles in subsection (2) is in addition to any other power of destruction in or under this Promulgation.

(4) Destruction of an article under this Promulgation may include any container, crate, baggage, package or mail which carries it.

(5) Packaging of an article may be considered as not part of a consignment and may be destroyed, if considered to pose a biosecurity risk, whether or not the article is destroyed.

(6) If the article to be destroyed appears to be of or above the value of $2,000, the biosecurity officer must obtain the written approval of the officer,s immediate supervisor before arranging for its destruction.

(7) The manner of destruction of articles under this section is as specified or approved by the Authority and the importer or owner of the article, if known, must be invited to witness the destruction.

(8) The Authority must give notice of an intention to destroy any article to the importer or owner in writing before the action is taken, if the importer or owner is known.

(9) No compensation is payable to the importer for destruction of an article under this section.

(10) The charges for destruction of an article under this section are as prescribed by the Authority.

*Post mortem examination of an animal*

64.—(1) If a biosecurity officer examining an animal pursuant to this Promulgation suspects that the animal is diseased and considers a post mortem examination to be necessary to establish a diagnosis, the officer may, on the written authority of the Authority, and without the consent of the owner—

*(a)* take or cause to be taken the life of the animal;

*(b)* cause a post mortem examination to be conducted to decide whether the animal is diseased; and

*(c)* obtain specimens from the animal for laboratory examination and diagnosis.

(2) If an examination is conducted pursuant to subsection (1), the results of the examination and of any laboratory reports resulting from the examination must be provided in writing to the Authority and to the owner of the animal, if the owner can be identified and located.

*Powers in relation to people*

65.—(1) If a biosecurity officer is of the opinion that any person—

*(a)* seeking to enter or leave the Fiji Islands;

*(b)* employed at a biosecurity point of entry or departure, in a designated area or quarantine station, or at approved premises; or

*(c)* engaged in importing or exporting regulated articles;

is in possession or control of an article that poses a biosecurity threat to the Fiji Islands, the officer may detain and question the person.

(2) If a biosecurity officer suspects that there may be upon a person seeking to enter the Fiji Islands an article that would, if imported, constitute an offence under this Promulgation, the officer may cause the person and the person's baggage to be searched.

(3) If a biosecurity officer suspects that there may be upon a person seeking to leave the Fiji Islands an article that would, if exported, constitute an offence under this Promulgation, the officer may cause the person and the person's baggage to be searched.

(4) A search of a person under this section must be carried out by 2 officers of the same sex as the person searched.

(5) A person may be detained under this section only for as long as is required to question and search the person and the person's baggage and to arrange for biosecurity measures to be taken in respect of it.

(6) A person who refuses—

*(a)* to answer to the best of his or her knowledge and ability questions reasonably put by a biosecurity officer; or

*(b)* to submit to a search reasonably required under this section, commits an offence.

(7) In this section, "person" means an individual.

## PART 9 — BIOSECURITY INTERNAL CONTROL

*Pest and disease surveys*

66.—(1) The Minister, on the advice of the Authority, may order a survey of any area of the Fiji Islands to be conducted to ascertain the status of pests and diseases in the area and the biosecurity risk of moving animals, plants, humans or organisms into, out of, or through the area.

(2) An order under this section—

*(a)* must be published as required by section 104(1);

*(b)* does not take effect until published in the *Gazette*.

(3) For the purposes of a survey under this section, a biosecurity officer may, in the area of the survey—

*(a)* inspect premises and equipment;

*(b)* take photographs and films and make drawings;

*(c)* inspect animals and plants and their products;

*(d)* question persons;

*(e)* collect specimens and perform tests relating to animals, plants, animal and plant products, land, water and the environment.

(4) For the purposes of a survey under this section, the Authority may direct the owners of animals or plants in the area of the survey, or persons who have custody or control of them, to make them available for inspection at places designated by the Authority.

(5) A person who refuses, in the course of a survey under this section –

*(a)* to permit an officer to enter property, collect specimens or perform tests as reasonably required;

*(b)* to answer to the best of his or her knowledge and ability oral or written questions reasonably put to the person by a biosecurity officer; or

*(c)* to make animals or plants in the ownership, custody or control of the person available as required under subsection (4),

commits an offence.

(6) The Authority may provide for the publication and transmission of survey results to other interested governments and organisations in compliance with international agreements.

*Entry, search and seizure*

67.—(1) If a biosecurity officer reasonably suspects the presence of a regulated pest or disease that is not under official control, the officer may -

*(a)* at any time stop, board and search any conveyance;

*(b)* at any time enter and search any premises, building or area, including a biosecurity holding area, biosecurity quarantine station or biosecurity approved premises and land adjacent to a dwelling house, but not a dwelling house;

*(c)* at any time with the consent of the owner, enter and search a dwelling house for animals, plants and their products;

*(d)* at any time, on a warrant issued under subsection (2), enter and search a dwelling-house for any regulated article that the officer reasonably suspects to be in it and to pose a biosecurity threat to the Fiji Islands.

(2) If a magistrate is satisfied on affidavit evidence by a biosecurity officer that—

*(a)* there may be in a dwelling house a regulated article that poses a biosecurity threat to the Fiji Islands; and

*(b)* the consent of the owner or occupier to entry and search of the dwelling house cannot be obtained,

the magistrate may issue a warrant authorising the officer to enter and search the dwelling house for the article.

(3) During a search of premises or a conveyance under this section a biosecurity officer may seize anything which—

*(a)* is a regulated article which the officer reasonably suspects poses a biosecurity threat to the Fiji Islands; or

*(b)* may be used as evidence of the commission of an offence under this Promulgation.

(4) A biosecurity officer who seizes anything from a person under subsection (3) must—

*(a)* inform the person of the reason for the seizure;

*(b)* give the person a receipt for the thing seized; and

*(c)* at the expense of the owner, remove the thing to a place of safekeeping and deal with it in accordance with this Promulgation.

(5) A biosecurity officer may submit to appropriate biosecurity measures any regulated article seized pursuant to this section.

*Detention and testing of animals and plants and their products*

68.—(1) If an animal or plant or animal or plant product in the Fiji Islands is suspected of being infected or infested by a regulated pest or disease, a biosecurity officer may direct the animal, plant or product to be detained and confined in a place specified by the Authority for tests to be conducted.

(2) Following detention under subsection (1), a biosecurity officer may test, or cause to be tested, any animal or plant or animal or plant product. Such tests may include—

*(a)* the taking of samples in accordance with section 59 (replacing references to the importer of an article by references to the owner or custodian of it);

*(b)* conducting a post mortem examination in accordance with section 64.

(3) If after testing as in subsection (2) the animal, plant or product is considered to pose a biosecurity threat to the Fiji Islands, the officer may further detain it in the specified place for biosecurity measures to be taken in respect of it, but an animal, plant or product may be detained only for so long as is required for biosecurity measures to be taken in respect of it.

(4) If an animal or plant or animal or plant product is to be detained under this section, a biosecurity officer may—

*(a)* direct the owner or custodian to remove it to the place specified under subsection (1);

*(b)* if necessary (because the owner or custodian refuses to obey the direction, or because of the nature of the biosecurity threat) arrange for the animal, plant or product to be removed to the specified place.

(5) If an animal or plant or animal or plant product is detained under this section, the owner or custodian must be given a written notice stating the reasons for the detention and, if it was removed under subsection (4)(b), the specified place.

(6) The cost of removal of an article to and its detention in a specified place under this section is to be borne by the Authority, and the owner is entitled to compensation for damage to or destruction of an article (but not consequential loss) caused as a result of any such removal or detention.

(7) Section 20 (Management of biosecurity holding areas) applies to places specified under this section as it applies to biosecurity holding areas, except that section 48(2) and (3) do not apply.

*Treatment or destruction of animals and plants and their products*

69.—(1) If treatment is available to eliminate or reduce to an acceptable level the biosecurity threat posed by an animal or plant or animal or plant product that has been detained under section 68, a biosecurity officer may—

*(a)* with the consent of the owner or custodian of the animal, plant or product, administer such treatment, or cause it to be administered;

*(b)* after treatment, release the animal, plant or product to the owner or custodian.

(2) If—

*(a)* in the opinion of a biosecurity officer, appropriate treatment is not available in the Fiji Islands;

*(b)* in the opinion of a biosecurity officer, there would still be a biosecurity risk after treatment; or

*(c)* the owner or custodian does not consent to the treatment being administered,

a biosecurity officer may order the animal or plant or product to be destroyed.

(3) Notice of action to be taken under subsection (2) must be given to the owner or custodian in writing before the action is taken.

(4) Subject to subsection (5), section 63 applies to the destruction of animals and plants and their products under this section, replacing references to the importer of an article by references to the owner or custodian of it.

(5) The cost of treatment or destruction under this section is to be borne by the Authority, and the owner is entitled to compensation (but not consequential loss) for destruction of an article under this section.

*Infested biosecurity controlled areas*

70.—(1) If—

*(a)* an animal or plant on land or premises in any area of the Fiji Islands is found to be infested by a pest or disease; and

*(b)* the powers in sections 67 to 69 are inadequate to control the outbreak,

the Minister, on the advice of the Authority, may by order declare the land or premises to be an infested biosecurity controlled area in respect of that pest or disease.

(2) An order under this section—

*(a)* may include an area of adjacent land if necessary to effectively contain the infestation;

*(b)* must be made as soon as practicable after the finding of the infestation;

*(c)* must be published as required by section 104(1);

*(d)* comes into effect on making, if so declared.

(3) In an infested biosecurity controlled area, a biosecurity officer may enter upon any land at any time in order to ascertain the status of a regulated pest or disease.

(4) In an infested biosecurity controlled area, pending the making of an order under section 71, no animal or animal product, or plant or plant product, fodder, fitting or other thing as specified in the declaration, may be moved out of, into or within the area except with the permission of a biosecurity officer and in accordance with any conditions reasonably imposed by the officer.

(5) A person who contravenes subsection (4) commits an offence.

*Regulation of infested biosecurity controlled areas*

71.—(1) In an infested biosecurity controlled area, the Authority may by order direct—

*(a)* the treatment or disposal of diseased animals and plants;

*(b)* the destocking, cleaning, disinfecting or other treatment of land, premises and conveyances;

*(c)* the inspection and treatment of regulated articles in or entering or leaving the area;

*(d)* any other biosecurity measures the Authority considers necessary to control the infestation.

(2) In respect of an infested biosecurity controlled area, the Authority may by order control—

*(a)* the movement of animals or plants or their products or other regulated articles into, out of or within the area;

*(b)* the movement of humans and conveyances into, out of or within the area;

*(c)* any other activity the Authority considers needs to be controlled to prevent the movement of host material into and out of the area.

(3) An order under subsection (1) or (2) may create offences for breaches of it and prescribe maximum penalties not exceeding a fine of $20,000 for an individual and $100,000 for a corporate body.

(4) An order under this section—

*(a)* must be published as required by section 104(1);

*(b)* does not take effect until published in the *Gazette*.

(5) Section 70(4) ceases to have effect upon the coming into force of an order under this section.

(6) The cost of treatment or destruction under this section is to be borne by the Authority, and the owner is entitled to compensation (but not consequential loss) for destruction of an article under this section.

*Pest-free biosecurity controlled areas*

72.—(1) The Minister, on the advice of the Authority, may by order declare any area of the Fiji Islands to be a pest-free biosecurity controlled area in respect of a specified pest or disease.

(2) A pest-free biosecurity controlled area is one where the specified pest or disease does not occur, so far as is known, and where incursions of that pest or disease should be prevented.

(3) An order under this section—

*(a)* must be published as required by section 104(1);

*(b)* does not take effect until published in the *Gazette*.

(4) Following a further survey conducted under section 66, and on the advice of the Authority, the Minister may amend or revoke an order made under subsection (1).

(5) Before advising the Minister under this section, the Authority must obtain appropriate scientific advice.

*Regulation of pest-free biosecurity controlled areas*

73.—(1) In respect of a pest-free biosecurity controlled area the Authority may by order—

*(a)* control the movement of regulated articles, humans and conveyances into, out of, and within the area;

*(b)* direct the inspection and treatment of regulated articles in or entering or leaving the area;

*(c)* establish surveillance procedures for the specified pest or disease in the area.

(2) An order under subsection (1)—

*(a)* must only be made for the purposes of preventing incursions of the specified pest or disease into the biosecurity controlled area;

*(b)* may create offences for breaches of the order and prescribe maximum penalties not exceeding a fine of $20,000 for an individual and $100,000 for a corporate body.

(3) An order under this section—

*(a)* must be published as required by section 104(1);

*(b)* does not take effect until published in the *Gazette*.

(4) The Authority may by administrative means institute other measures to keep the biosecurity controlled area free of the specified pest or disease.

*Destruction of wild and astray animals*

74.—(1) If the Authority has reason to suspect that a wild, feral or stray animal is carrying a regulated pest or disease, the Authority may, in order to prevent the pest or disease from being established or spreading in the Fiji Islands, after consultation with its technical section heads, cause the animal to be destroyed.

(2) The carcass of an animal destroyed under subsection (1) must be disposed of in a manner that will not create the risk of the spread of any regulated pest or disease.

*Notifiable pests and diseases*

75.—(1) The Authority may by order declare—

*(a)* the pests and diseases that are notifiable for purposes of this section;

*(b)* the manner of notifying such pests and diseases to the Authority.

(2) An order under this section—

*(a)* must be published as required by section 104(1);

*(b)* does not take effect until published in the *Gazette*.

(3) A person who knows of or suspects the occurrence of a notifiable pest or disease in the Fiji Islands must as soon as reasonably practicable notify the Authority in the manner declared under subsection (1), unless the person reasonably believes that the Authority has already been notified of the occurrence.

(4) A person who fails to comply with subsection (3) commits an offence.

(5) The master of a vessel or captain of an aircraft in the Fiji Islands who knows of or suspects the occurrence of a notifiable pest or disease on board the vessel or aircraft must –

*(a)* as soon as reasonably practicable notify the Authority in the manner declared under subsection (1); and

*(b)* take such action in relation to the vessel or aircraft as is directed by the Authority or a biosecurity officer.

(6) A master or captain who fails to comply with subsection (5)*(a)* or *(b)* commits an offence.

(7) The Authority must record in the biosecurity register all occurrences of notifiable diseases that are notified under this section or that otherwise come to the notice of the Authority.

*Beneficial organisms and bio-control agents*

76.—(1) The Minister may in writing authorise the release of beneficial organisms or biocontrol agents that are necessary or appropriate for the control or eradication of a particular pest or disease in the Fiji Islands.

(2) Before authorising a release under subsection (1) the Minister must obtain the advice of the Authority as to the biosecurity risk posed by the release and consult as appropriate the officers or authorities responsible for agriculture, fisheries, environment and natural resources.

(3) An authorisation under subsection (1) must identify –

*(a)* the organism or agent;

*(b)* the pest or disease which it is intended to control;

*(c)* the area where it may be released;

*(d)* the period during which it may be released;

*(e)* the person or persons who may release it; and

*(f)* any conditions subject to which the approval is granted.

(4) No liability attaches to the Minister, the Authority or any public officer in respect of the release of organisms or biocontrol agents in accordance with this section, except on proof of negligence or malice.

(5) The Authority must record in the biosecurity register -

*(a)* the names of any beneficial organisms or biological agents released under this section; and

*(b)* the place of and extent of release of such organisms and agents.

(6) In this section, "beneficial organism" and "biocontrol agent" mean a natural enemy, antagonist or competitor of a pest or disease, and any other self-replicating biotic entity used for pest and disease control.

(7) Before advising the Minister under subsection (2), the Authority must obtain appropriate scientific advice.

## PART 10 — BIOSECURITY EMERGENCIES

*Declaration of a biosecurity emergency area*

77.—(1) On receiving evidence that a biosecurity emergency has arisen in the whole or any part of the Fiji Islands, the Minister may declare a biosecurity emergency in respect of the whole of or that part of the Fiji Islands.

(2) Before making a declaration under subsection (1), the Minister must obtain the advice of the Authority and consult the National Disaster Management Council.

(3) A biosecurity emergency area may include an area where an animal or plant is found to be infested or infected, and adjacent areas to the extent reasonably necessary.

(4) Notice of a declaration under this section must be—

*(a)* published as required by section 104(1);

*(b)* displayed on noticeboards or similar throughout the biosecurity emergency area.

(5) A declaration under subsection (1)—

*(a)* does not take effect until it has been published in the *Gazette*;

*(b)* must be revoked as soon as the biosecurity threat is removed or reduced to an acceptable degree.

(6) A declaration under subsection (1) expires on the date which is 6 months after it comes into force unless it is revoked or extended on or before that date by the Minister and subsection (2) applies to such a resolution.

(7) An extension of a biosecurity emergency declaration may not be for more than 6 months from the date of the resolution, but may be renewed in the same manner before the end of that period.

*Response to a biosecurity emergency*

78.—(1) When a biosecurity emergency area is declared under section 77, the Authority must undertake a detailed survey, using the powers in section 66, to ascertain the precise extent and severity of the incursion or other threat and the most appropriate measures to take in response.

(2) In deciding on an appropriate response to a biosecurity emergency, the Authority should—

*(a)* be guided by any Biosecurity Emergency Response Plan that has been devised by the Authority in consultation with other departments of government and statutory authorities;

*(b)* as appropriate, consult and liaise with the National Disaster Management Council.

(3) If the cost of a response to an emergency exceeds or is likely to exceed the current budget of the Authority, the Minister should request the Cabinet for additional funds, as provided by section 14(3).

*Action in a biosecurity emergency area*

79.—(1) In respect of a biosecurity emergency area—

*(a)* *the CEO may request the Commissioner of Police and any department of government or* statutory Authority to use their powers and resources to assist in the control or eradication of any pest or disease in the area;

*(b)* the CEO may in writing requisition for the use of the Authority any conveyance or equipment which the Authority reasonably considers is necessary or useful for preventing, eradicating or limiting the spread of a pest or disease;

*(c)* a biosecurity officer may enter upon any land at any time in order to ascertain the status of a pest or disease;

*(d)* the CEO may appoint temporary additional personnel, whether or not having the powers of biosecurity officers, to effectively respond to the biosecurirty emergency.

(2) In a biosecurity emergency area, the Authority may do or cause to be done any of the following—

*(a)* mark the boundaries of the emergency area;

*(b)* set up roadblocks at all exits from the area;

*(c)* set up facilities for the cleansing and disinfection of all persons and conveyances entering or leaving the area and any other thing likely to spread any pest or disease;

*(d)* disinfect all conveyances, crates, packing, animals, plants and other things which are likely to carry pests or diseases and which are being sent out of the area;

*(e)* inspect and disinfect all persons and their possessions leaving the area so as to prevent any host material that may be infected from leaving the area;

*(f)* for the purposes of paragraphs (d) and (e), detain persons, animals, plants, animal and plant products, goods and vehicles for as long as is necessary to minimise or eliminate the biosecurity risk presented by them;

*(g)* perform surveillance activities to ascertain the extent and status of the emergency.

(3) A person who—

*(a)* resists, knowingly obstructs, or knowingly and without reasonable excuse fails to comply with a direction of the Authority, a biosecurity officer or any police officer or other person performing duties under this section;

*(b)* knowingly enters or leaves a biosecurity emergency area except with and in accordance with the permission of the Authority or a biosecurity officer; or

*(c)* knowingly moves any article out of or into a biosecurity emergency area, or from one place within the area to another place within that area, except with and in accordance with the written permission of the Authority or a biosecurity officer,

commits an offence.

(4) Articles moved in contravention of subsection (3)(c) may be seized by a biosecurity officer and—

*(a)* held pending criminal proceedings for the contravention; or

*(b)* if necessary to remove a biosecurity threat, destroyed as the Authority directs, without a court order.

(5) In respect of action taken under this section—

*(a)* the cost of treatment or destruction of any article is to be borne by the Authority;

*(b)* compensation (but not for consequential loss) is payable to the owner of any land, premises, conveyance or article that is used, lost, destroyed or damaged.

*Biosecurity Emergency Regulations*

80.—(1) The Minister, on the advice of the Authority, may at any time make regulations ("Biosecurity Emergency Regulations") which—

*(a)* supplement the powers given to the CEO and Authority and biosecurity officers by section 79; and

*(b)* take effect upon the declaration of a biosecurity emergency area under section 78.

(2) Biosecurity Emergency Regulations may, in respect of a biosecurity emergency area—

*(a)* create one or more exclusion zones within the area and control the movement of conveyances, humans, animals and plants and host material into, out of and within such a zone;

*(b)* prohibit specified activities in the area;

*(c)* provide for the destruction or treatment of specified goods and the treatment of land in the area;

*(d)* regulate the use of the area for a specified period after the lifting of emergency restrictions;

*(e)* generally, specify the conditions which apply to the area to control the biosecurity emergency.

(3) Biosecurity Emergency Regulations may—

*(a)* confer on the CEO and Authority and on biosecurity officers powers additional to those conferred by this Promulgation and reasonably needed to deal with the emergency;

*(b)* prescribe the disposal, destruction, treatment or other measures to be adopted in respect of any item which is infected, infested or contaminated;

*(c)* require the cleansing or disinfecting of soil, conveyances, machinery, tools, equipment, clothing, footwear or other things which may have come into contact with those items;

*(d)* prescribe measures to be taken to prevent pests and diseases from spreading, including but not limited to cleansing of homes and utensils, removal of stagnant water and disposal of garbage;

*(e)* prohibit or restrict the use of any seaport or airport, or of any facilities at any seaport or airport, to the extent specified.

(4) Biosecurity Emergency Regulations may create offences for breaches of them and prescribe maximum penalties not exceeding a fine of $40,000 for an individual or $200,000 for a corporate body.

(5) Biosecurity Emergency Regulations come into force on the day on which a biosecurity emergency declaration takes effect under section 77 and lapse upon the expiry of the declaration under that section. They come into force again if a further declaration is made under section 77.

(6) In respect of action taken under Biosecurity Emergency Regulations –

*(a)* the cost of treatment or destruction of any article is to be borne by the Authority;

*(b)* compensation (but not for consequential loss) is payable to the owner of any land, premises, conveyance or article that is used, lost, destroyed or damaged.

## PART 11 — ADMINISTRATION OF THE PROMULGATION

*Biosecurity register and records*

81.—(1) The Authority must maintain a biosecurity register and other records needed for the administration of this Promulgation and the performance of the functions of the Authority.

(2) Without limiting the matters to be recorded in the biosecurity register, details of the following must be included—

*(a)* regulated pests and diseases;

*(b)* prohibited imports;

(c) biosecurity points of entry and departure;

(d) biosecurity holding areas;

(e) biosecurity clearance agents;

(f) biosecurity port quarantine areas;

(g) biosecurity quarantine stations;

(h) biosecurity approved premises;

(i) biosecurity import permits issued, refused and revoked under Part 5;

(j) exemptions granted under section 39;

(k) transit waivers issued under section 40, other than in-transit passenger waivers;

(l) biosecurity controlled areas declared under section 70 or 72;

(m) occurrences of notifiable pests and diseases notified under section 75;

(n) beneficial organisms and biocontrol agents released under section 76;

(o) agreements and memoranda of understanding with other government departments, statutory authorities and overseas agencies under section 83(3);

(p) compliance agreements entered into by the Authority under section 87;

(q) bilateral agreements entered into with potential receiving countries under section 89;

(r) any other matter required by or under this Promulgation or considered by the Authority to be necessary or appropriate for inclusion in the biosecurity register.

(3) The Authority must include in the biosecurity register details of—

(a) specifications for regulated articles made under sections 34 and 44, including the biosecurity measures appropriate to each type of regulated article;

(b) any other form or matter prescribed or specified by the Authority under this Promulgation.

(4) In respect of the biosecurity requirements of receiving countries, the biosecurity register must include details of—

(a) the requirements of those countries for which biosecurity export clearance has been granted in the past 12 months;

(b) source material for ascertaining the biosecurity requirements of all potential receiving countries.

(5) The Authority must maintain records relating to its functions, including, but not limited to—

(a) financial and resource management records, with budgets and records of expenditure and revenue, in accordance with Part B of Schedule 4;

(b) personnel records including the identities, duty statements and terms and conditions of employment of all biosecurity officers and other employees;

(c) operational statistics relating to the biosecurity functions of the Authority.

*Status of biosecurity register and records*

82.—(1) The biosecurity register kept pursuant to section 81(1) must be made available for inspection and copying by members of the public during office hours at the office of the Authority on payment of the prescribed fee.

(2) Subject to any other Act, the biosecurity register and other records kept under section 81 must only be used for the purposes of this Promulgation.

(3) A copy of an entry in the biosecurity register which is certified by the Authority to be an accurate copy may be produced in court as prima facie evidence of the entry.

(4) The biosecurity register and other records kept under section 81 may be in electronic format, provided the information is readily retrievable and is protected against unintended loss.

(5) The Minister, on the advice of the Authority, may by order determine the period for which entries in the biosecurity register and other records under section 81 must be kept, consistent with any other Act relating to public records.

*Consultation and outsourcing*

83.—(1) Before making subsidiary legislation, issuing directions or exercising other powers under this Promulgation, the Minister, CEO and Board should each obtain appropriate technical advice and consult relevant interested parties, but failure to do so does not invalidate the exercise of the relevant powers.

(2) Before exercising a power under this Promulgation that will or might affect matters within the responsibility of another government department or statutory authority (including but not limited to human health, natural resources, environment, tourism, postal services, shipping, aviation, transport and trade) the Minister, CEO and Board should each consult the relevant department, authority or officer, but failure to do so does not invalidate the exercise of the power.

(3) The Authority may, for the effective implementation of this Promulgation, enter into memoranda of understanding or other agreements with other government departments and statutory authorities and with official agencies and private organizations in the Fiji Islands or elsewhere.

(4) The Authority may—

*(a)* hire the services of a laboratory for testing of samples;

*(b)* hire consultants to perform biosecurity risk assessments and to carry out surveys authorised under this Promulgation;

*(c)* hire any treatment or other service deemed necessary for the effective implementation of this Promulgation.

(5) Outsourcing of services under subsection (4) does not confer on any person the powers of a biosecurity officer.

*Duty to coordinate*

84.—(1) Biosecurity officers and other persons administering this Promulgation should so far as possible coordinate their functions with those of officers of other government departments and statutory authorities, in respect of border control, the movement of vessels and aircraft, human health, biosecurity internal control and compliance with the laws of the Fiji Islands generally.

(2) Without limiting subsection (1),—

*(a)* biosecurity officers should notify officers of the customs and immigration services of any breach of the customs or immigration Laws that comes to their notice;

*(b)* officers of the customs and immigration services and of the postal service should—

(i) notify a biosecurity officer of the importation or proposed exportation of any uncleared regulated article that comes to their notice;

(ii) hand over to a biosecurity officer any such article which comes into their possession for inspection and treatment in accordance with this Promulgation;

*(c)* police officers, customs officers, immigration officers, postal service officers, environmental officers, agriculture officers, livestock officers, forestry officers and fisheries officers should co-operate with biosecurity officers in the performance of their functions under this Promulgation and render such assistance as they can lawfully do when called upon by the Authority or a biosecurity officer.

(3) The Authority should seek so far as possible to coordinate the biosecurity functions of the Authority with those of other government departments and statutory authorities dealing with the police, customs, immigration, marine, harbours, civil aviation, health, environment, fisheries, natural resources and similar services.

*Facilities at biosecurity points of entry or departure*

85.—(1) The operator of every biosecurity point of entry or departure in the Fiji Islands must, to the extent possible, provide on the premises, for the purposes of this Promulgation and to the satisfaction of the Authority—

*(a)* an area suitable for use as offices by biosecurity officers stationed at the point;

*(b)* adequate space for the display of notices regarding the biosecurity requirements of this Promulgation;

*(c)* areas for interview and, if necessary, physical examination of incoming passengers and crew, if required;

*(d)* biosecurity holding areas as designated under section 19;

*(e)* facilities and suitable containers for garbage collection and incineration or other disposal;

*(f)* facilities for the incineration or other disposal of regulated articles without creating an unacceptable biosecurity risk;

*(g)* fencing of premises in which garbage holding and disposal equipment is situated;

*(h)* any other facilities the Authority reasonably requests in writing as being needed for the performance of biosecurity functions at the point of entry or departure.

(2) The operator of a biosecurity entry or departure point, whether or not a public officer, must keep the premises and facilities mentioned in subsection (1)*(e)*, *(f)* and *(g)* free from weeds and vermin to the satisfaction of the Authority. An operator who fails to do so commits an offence.

(3) No charge is payable by the Authority for the facilities to be provided under this section. If an operator fails to provide facilities as required by this section they may be provided by the Authority and the cost of such provision is a debt owing by the operator to the Authority.

*Safe carriage and safe working environment*

86.—(1) If it is necessary for the purposes of this Promulgation for a biosecurity officer to be transported to a conveyance, premises or place, the owner of the conveyance, premises or place must ensure that the mode of transport provides safe carriage having regard to the conditions of travel.

(2) If it is necessary for an officer to undertake inspection duties on a conveyance or premises, including a conveyance or premises owned by the Government or Authority, the person in charge of the conveyance or premises must provide a safe working environment for the officer.

(3) The Minister s power to make regulations under section 106 includes the power to make regulations, consistent with the health and safety Laws of the Fiji Islands, to enforce the obligations stated in subsection (1) and (2).

*Compliance agreements*

87.—(1) The Authority may enter into a written agreement with an importer, exporter, producer or any other person in connection with—

*(a)* the application of particular biosecurity measures in respect of any item;

*(b)* the way in which any requirement under this Promulgation can be satisfied by the person; and

*(c)* the supervision, monitoring and testing of the person s compliance with those measures or that requirement.

(2) A compliance agreement may provide that, in circumstances stated in the agreement, the Authority may, by written notice, cancel or vary the agreement or suspend its operation for a period. The circumstances may include, but are not limited to, the person s failure to comply with specified measures or meet specified requirements.

(3) A biosecurity officer may release an article to which a compliance agreement applies, and if it is a regulated article grant biosecurity clearance in respect of it, on the basis of a written certificate, given by a person authorised under the agreement to give such a certificate, that all the measures to which the agreement refers have been complied with in respect of the article.

*Biosecurity approved premises*

88.—(1) The Authority, on written application by the owner or occupier of any premises and on payment of the prescribed fee, may in writing—

*(a)* approve the premises as premises where the inspection, testing and treatment of regulated articles can take place; and

*(b)* approve specified action being taken under this Promulgation in relation to all regulated articles, or specified articles, while they are in the approved premises.

(2) In deciding whether to give approval under subsection (1), the Authority, after inspection of the premises by a biosecurity officer, must take into account -

*(a)* whether the specified action can be taken in the premises without an unacceptable biosecurity risk and without contravening this Promulgation or the conditions of any permit;

*(b)* whether the premises and facilities in them are adequate to enable such action to be taken efficiently and safely;

*(c)* whether the location of the premises is appropriate having regard to the nature of the articles, the specified action and the level of biosecurity risk;

*(d)* whether the premises are located in a place where biosecurity officers can conveniently check that this Promulgation and the regulations are being complied with in the premises; and

*(e)* any other matter the Authority considers relevant.

(3) An approval under this section may be expressed to be subject to conditions stated in the approval and is of no effect if the conditions are not met.

(4) An approval under this section has effect for a period not exceeding 12 months but may be renewed by following the procedure for a new approval.

(5) An approval under this section may be cancelled if the Authority is satisfied—

*(a)* that the premises or facilities or action taken do not comply with this Promulgation or the regulations; or

*(b)* that the premises are otherwise no longer suitable for approval.

(6) The provisions of this Promulgation relating to biosecurity quarantine stations (other than section 48) apply to premises approved under this section.

*International cooperation*

89.—(1) The Minister, in consultation with the Ministers for foreign affairs and trade, may, with the approval of the Cabinet, enter into bilateral or multilateral agreements with countries and international organisations for effective international control in biosecurity matters.

(2) The Authority may pursuant to such agreements—

*(a)* exchange information with other countries and international organisations;

*(b)* contribute to the development of international sanitary and phytosanitary standards.

(3) Agreements under subsection (1) may include agreements on procedures for implementing this Promulgation, but not so as to vary the effect of any of its provisions except as provided by this Promulgation.

(4) The Minister must use his or her best endeavours to implement in the Fiji Islands international standards and requirements relating to biosecurity, and to that end should—

*(a)* designate one or more officers in the Authority as the enquiry point and notification authority for purposes of the IPPC, the OIE and the PPPO;

*(b)* seek to ensure that notification and reporting requirements of the IPPC, the OIE , the PPPO and any other international agreement relating to biosecurity imposed on the Fiji Islands are met in a timely manner.

*Notifications*

90.—(1) The Minister, on the advice of the Authority, may at any time issue a notice—

*(a)* stating that a specified pest or disease is known to exist in the Fiji Islands;

*(b)* stating that, to the best of the Minister s knowledge, a specified pest or disease does not exist in the Fiji Islands;

*(c)* specifying the classification, name or identity by which any animal, animal product, plant, plant product, pest or disease is known in the Fiji Islands.

(2) A notice issued under subsection (1) is, for the purposes of this Promulgation, conclusive until revoked or amended under that subsection and is admissible in any court or other proceedings as evidence of the matters stated in it.

## PART 12 — OFFENCES AND PENALTIES

*Dereliction of duty by officers*

91. A biosecurity officer who—

*(a)* fails without reasonable excuse to perform any of his or her duties under this Promulgation or the regulations;

*(b)* disposes of a regulated article or other item under the control of the officer other than in accordance with this Promulgation;

*(c)* discloses information of a confidential or commercial nature which has come into the officer s possession while performing functions under this Promulgation, except for purposes of this Promulgation;

*(d)* in the course of performing his or her duties molests or intimidates unlawfully assaults any person;

*(e)* in connection with his or her duties solicits or accepts a bribe; or

*(f)* knowingly or recklessly makes a false or misleading statement, or issues a false or misleading certificate or other document, while purporting to perform his or her duties,

commits an offence.

*Obstruction, false information etc.*

92. A person who—

*(a)* wilfully fails to comply with a lawful request made or direction given by a biosecurity officer under this Promulgation;

*(b)* knowingly obstructs a biosecurity officer in the performance of his or her functions under this Promulgation;

*(c)* assaults, or threatens to assault a biosecurity officer performing functions under this Promulgation;

*(d)* bribes a biosecurity officer in relation to the performance of functions under this Promulgation;

*(e)* makes a false or incomplete statement, whether orally or in writing, in relation to any matter under this Promulgation, intending to mislead a biosecurity officer in the performance of functions under this Promulgation,

*(f)* for purposes of this Promulgation knowingly or recklessly –

(i) makes a false or misleading biosecurity declaration; or

(ii) issues any false or misleading certificate;

*(g)* knowingly or recklessly gives false or misleading information to a biosecurity officer while the officer is performing functions under this Promulgation,

commits an offence.

*Fraudulent use of official documents*

93.—(1) A person to whom a permit or other document is issued under this Promulgation who—

*(a)* forges or unlawfully alters the document;

*(b)* allows any other person to use or attempt to use the document for any purpose of this Promulgation,

commits an offence.

(2) A person who, for the purposes of this Promulgation, produces a document which is false or misleading, knowing it to be so and intending another person to rely on it, commits an offence.

(3) A person who uses or affixes an official stamp or seal required under this Promulgation, without lawful authority and with intent to defraud or deceive, commits an offence.

*Maximum penalties*

94—(1) An individual who commits an offence under a section of this Promulgation listed in column 2 of Schedule 5 is liable on summary conviction to the maximum penalties respectively listed in columns 4 and 5 of Schedule 5.

(2) The penalties listed in Schedule 5 are maxima and a court may impose on an individual any penalty for an offence up to the amount of fine or period of imprisonment (or both) listed in respect of the offence.

(3) A body corporate that commits an offence is liable to a maximum fine of 5 times the maximum fine for the same offence if committed by an individual, as prescribed in Schedule 5.

*Forfeiture*

95.—(1) A court convicting a person of an offence under this Promulgation or the regulations may, in addition to any other penalty imposed, order that any article used in committing the offence, or, if the article has been sold, the proceeds of the sale, be confiscated.

(2) If an article or proceeds are confiscated under subsection (1)—

*(a)* the article or proceeds are forfeited to the Authority;

*(b)* a forfeited article may be sold and the proceeds of sale paid into the funds of the Authority; or

*(c)* if the article poses a biosecurity threat it must be destroyed as directed by the Authority.

(3) For the purposes of subsection (1), "article used in committing the offence" includes equipment, a conveyance and any other movable thing owned by the offender which was used directly in the commission of the offence, but does not include land or buildings and fixtures on land.

(4) In deciding whether to order confiscation of any article or proceeds under this section, a court must have regard to the principle of proportionality.

*Fixed penalty system*

96.—(1) The Authority, if of the opinion that a person has committed an offence under this Promulgation, may as an alternative to prosecuting the person—

*(a)* order the person to pay a fixed penalty as described in subsection (2); and

*(b)* order any goods liable to confiscation in connection with the offence to be forfeited to the State or, if they pose a biosecurity threat, to be destroyed.

(2) The fixed penalty referred to in subsection (1) is as set out in column 6 of Schedule 5. If no figure is shown in that column, the fixed penalty option is not available.

(3) The fixed penalty for a body corporate is 5 times that for an individual.

(4) Before imposing a fixed penalty order on a person for an offence, the Authority must notify the person in writing, giving particulars of the offence, the maximum penalty that a court could impose, the fixed penalty that is proposed, and any item that will be confiscated.

(5) If a person on whom a notice is served under subsection (4)—

*(a)* within the time specified in the notice, and in writing, admits the offence, requests the Authority to deal with it under this section and consents to the confiscation of the item (if appropriate) - the Authority may impose a fixed penalty order on the person;.

*(b)* does not respond as in paragraph (a) within the time specified in the notice - the Authority may prosecute the offence.

(6) A fixed penalty order must—

*(a)* be in writing and specify the offence which the person has committed, the fixed penalty that is imposed, the place where it is to be paid and the date by which it is to be paid;

*(b)* specify any item that is to be forfeited or destroyed.

(7) A person against whom an order is made under this section is not liable to any further criminal proceedings in respect of the offence and if in custody must be discharged.

(8) If a fixed penalty payable under this section, or any part of it, is not paid by the date specified in the order, the sum payable becomes a debt owing to the Authority and the Authority may –

*(a)* request the Director of Immigration to place a stop order on the person leaving the country until the sum is paid; and either –

*(b)* send a copy of the order to a court of competent jurisdiction

which may enforce payment of the sum outstanding as if it were a fine imposed by the court., including imposing costs and confiscation as appropriate; or

*(c)* prosecute the offence.

(9) The Minister s power to make regulations under section 106 includes the power to make regulations to supplement the provisions of this section in relation to fixed penalty notices, including the imposing of stop orders to prevent a person leaving the country until the sum is paid.

*Offences by corporate bodies*

97.—(1) A corporate body cannot be imprisoned for an offence under this Promulgation or the regulations, but the maximum fine for such an offence by a corporate body is as stated in section 94(3).

(2) If a corporate body commits an offence against this Promulgation, every person who is a board member or director or otherwise concerned in the management of the body also commits the offence as an individual, unless the person proves—

*(a)* that the offence was committed without his or her consent or connivance; and

*(b)* that he or she exercised reasonable diligence to prevent the commission of the offence, having regard to the nature of his or her functions in the corporate body and to all the circumstances.

## PART 13 — MISCELLANEOUS PROVISIONS

*Civil and criminal proceedings*

98.—(1) Notwithstanding any limit on its jurisdiction in any other Law, a magistrate s court is competent to impose any penalty or to make any order provided for in or under this Promulgation.

(2) The Authority may institute and conduct proceedings for an offence under this Promulgation, subject to the right of the Director of Prosecutions to institute, take over or terminate criminal proceedings at any time.

(3) The Authority may institute and conduct proceedings for the recovery of a debt owing to the Authority under this Promulgation.

*Abandoned goods*

99.—(1) An article may be treated as abandoned and disposed of under this section if—

*(a)* any fee or charge payable by a person under this Promulgation or the regulations in respect of the article is not paid within 3 months of the notice of the fee or charge being served on the person;

*(b)* the article is in a biosecurity holding area and is not removed from the area within 14 days after biosecurity entry clearance has been granted in respect of it; or

*(c)* the article is in biosecurity quarantine and is not removed from a biosecurity quarantine station or biosecurity approved premises within 14 days after the end of the quarantine period in respect of it.

(2) An article that has been abandoned may be destroyed, sold or otherwise disposed of in the prescribed manner, or, in the absence of regulations, in any manner the Authority thinks fit that does not present a biosecurity risk.

(3) The cost of disposal of an abandoned article is a debt due to the Authority by the person who was the owner of it, and proceeds of any sale or disposal of an abandoned article revert to the Authority.

*Compensation*

100.—(1) Except as otherwise provided in or under this Promulgation, no compensation is payable for loss of or damage to any item as a result of any search, inspection, examination, sampling, testing, detention, treatment, quarantine or other biosecurity measure taken under this Promulgation or the regulations, unless negligence or malice on the part of the person taking the measure is proved.

(2) Compensation is not payable under this Promulgation, or may be reduced proportionately, if the biosecurity measures that caused the loss or damage were occasioned by a wilful or negligent act or omission of the person claiming compensation.

(3) If this Promulgation provides for payment of compensation in any circumstances, the compensation must be—

*(a)* claimed in accordance with a specified procedure;

*(b)* if not agreed, determined by the Authority in accordance with specified rates, not exceeding the market value of the item plus consequential loss reflecting contemporary costs;

*(c)* paid out of the funds of the Authority.

(4) An appeal against a determination under subsection (3) lies to the High Court.

*Appeals from decisions*

101.—(1) A person who is aggrieved by a decision of a biosecurity officer under this Promulgation may within 24 hours from the time he or she receives the decision appeal to the biosecurity officer s immediate supervisor.

(2) A person who is aggrieved by the decision of a supervisor under subsection (1), may within 24 hours from the time he or she receives the decision appeal in writing to the Manager.

(3) A person who is aggrieved by a decision of the Manager, may, within 24 hours from the time he receive the decision, appeal in writing to the CEO, whose decision is final.

(4) The lodging of an appeal in respect of an article does not prevent biosecurity measures being taken in respect of the article to reduce or eliminate the biosecurity risk posed by the article, and section 102 applies to the taking of such measures.

(5) The person deciding an appeal must give the appellant and the respondent the opportunity to be heard, in writing or in person, and to produce evidence and call witnesses, and must give reasons for the decision on the appeal.

(6) If an appeal involves a technical issue, the person hearing the appeal must obtain the advice of the relevant technical section head.

(7) An appeal in respect of compensation is to be dealt with as provided in section 100(4).

*Limitation of liability*

102.—(1) Neither the Authority, the Minister, the Board, the CEO, or any biosecurity officer or other public officer is personally liable for action taken under this Promulgation in good faith and without negligence.

(2) A breach of a duty imposed on the Authority, the Minister, the Board, the CEO, a biosecurity officer or any other public officer by or under this Promulgation does not give rise to any civil liability except as provided by or under this Promulgation.

*Evidence*

103.—(1) In any proceedings under this Promulgation—

*(a)* a document purporting to have been issued by the Minister, CEO, Board or by a biosecurity officer or other public officer for the purposes of this Promulgation is presumed, until the contrary is proved, to have been duly executed or signed by that person;

*(b)* a copy of or extract from a document issued by the Minister, Board, CEO or by a biosecurity officer or other public officer, and certified by the Authority or person to be true and correct is, unless the contrary is proved—

(i) presumed to be a true and correct copy or extract;

(ii) on its production in court prima facie proof of any matter contained in it.

(2) In any proceedings under this Promulgation—

*(a)* a certificate, in a form approved by the Authority, of the results of any test conducted on an article by the person who conducted the test may be tendered in evidence and is prima facie evidence of the facts stated in it;

*(b)* a certificate of analysis of a sample of any article or thing may be tendered in evidence and is prima facie evidence of the facts stated in it if the procedure prescribed in relation to the sample has been substantially followed.

(3) Section 81 governs the evidential status of the biosecurity register and records kept under this Promulgation.

*Publication of orders and notices*

104.—(1) Regulations and legislative orders made under this Promulgation must be published—

*(a)* in the *Gazette*;

*(b)* at the office of the Authority and on the Authority website, if any;

*(c)* on any radio or television station that broadcasts in the affected area;

*(d)* in any newspaper that circulates in the affected area;

*(e)* at any government or local authority offices that are in or adjacent to the affected area.

and made available to the public for inspection or purchase.

(2) Regulations and legislative orders made under this Promulgation do not take effect until published in the *Gazette,* unless otherwise provided.

(3) Unless otherwise provided, and subject to subsection (4), notice required by this Promulgation to be given may be given electronically—

*(a)* by a person to the Authority ;

*(b)* by the Authority to a person, if the person has given the Authority an electronic address for receipt of such notices.

(4) If service of a notice or other document on a person is to be proved in a court, it must be effected -

*(a)* by personal service on the person; or

*(b)* by registered post to the address of the person given to the Authority, in which case service is presumed to have been effected 2 days after posting.

(5) The CEO may give instructions and directions to biosecurity officers by electronic means.

(6) A printed copy of an electronic record of a notice, instruction or direction given or received by electronic means is prima facie evidence of the notice if the record purports to have been made at the time of sending or receipt.

*Specifications*

105.—(1) The Authority may in writing specify—

*(a)* documents and forms for use in connection with this Promulgation, including the format of documents transmitted by electronic means;

*(b)* the procedures for applying for and issuing permits and other documents;

*(c)* all other matters that can or must be specified, as provided for in this Promulgation.

(2) If a matter is prescribed by regulations or an order, the regulations or order take precedence over a specification on the same matter.

(3) Specifications must be entered in a biosecurity register maintained under section 81 and do not take effect until so entered.

(4) Section 82 governs the evidential status of a specification contained in a biosecurity register.

(5) Unless otherwise provided, section 104(1) does not apply to specifications made under this Promulgation and entered in a biosecurity register, but they must be -

*(a)* published in the biosecurity register and at the offices of the Authority;

*(b)* published in any operations manual provided to biosecurity officers pursuant to section 9(6)*(b)*; and

*(c)* made available to the public for inspection or purchase.

*Regulations*

106.—(1) The Minister may make regulations not inconsistent with this Promulgation for the effective implementation of this Promulgation, other than regulations that can be made by the Authority under subsection (5).

(2) Without limiting subsection (1) or affecting any other regulation-making power in this Promulgation, regulations made by the Minister may—

*(a)* prescribe the method of taking and analyzing samples, recording the results and disposing of the samples;

*(b)* prescribe the manner of disposal of abandoned goods under section 99;

*(c)* prescribe the procedure for claiming compensation, and the rates payable, pursuant to section 100;

*(d)* regulate the procedure on appeals under section 101;

*(e)* provide for the de-ratting of vessels, and the form of de-ratting certificate;

*(f)* regulate the disposal of garbage and waste and second-hand clothing and bedding so as to minimise any biosecurity risk;

*(g)* prescribe additional measures, consistent with this Promulgation, to implement in the Fiji Islands the standards and requirements relating to biosecurity of the IPPC, the OIE and the PPPO;

*(h)* prescribe any other matter which this Promulgation requires to be prescribed by the Minister.

(3) Before making regulations under this section, the Minister must—

*(a)* obtain the advice of the Authority; and

*(b)* consult any local authority whose area of jurisdiction will be affected, and other government departments and statutory authorities as appropriate.

(4) The Authority may make regulations relating to the performance of the functions of the Authority.

(5) Without limiting subsection (4) or affecting any other regulation-making power in this Promulgation, regulations made by the Authority may—

*(a)* prescribe fees and charges for services provided by the Authority;

*(b)* provide for the electronic filing of declarations and applications required by this Promulgation and the electronic keeping of registers;

*(c)* prescribe the language of documents required by this Promulgation;

*(d)* prescribe the manner and language of markings on containers of incoming and outgoing regulated articles;

*(e)* prescribe the methods of handling and sealing and disposal of containers of regulated articles;

*(f)* provide for the placing and use of amnesty bins or other containers for regulated articles at points of entry;

*(g)* subject to the approval of the civil aviation and maritime authorities, require a video film about biosecurity to be shown on all aircraft and vessels arriving in the Fiji Islands and carrying passengers;

*(h)* require treatment to be applied in respect of a vessel or aircraft before it arrives in the Fiji Islands;

*(i)* prescribe additional measures, consistent with this Promulgation, to implement in the Fiji Islands the standards and requirements relating to biosecurity of the IPPC, the OIE and the PPPO;

*(j)* prescribe any other matter that is necessary for performing the functions of the Authority and that is not prescribed by the Minister.

(6) Before making regulations under this section, the Authority must—

*(a)* obtain the written approval of the Minister; and

*(b)* consult any local authority whose area of jurisdiction will be affected, and other government departments and statutory authorities as appropriate.

(7) Regulations made under this section may create offences for breaches of them and prescribe maximum penalties not exceeding a fine of $20,000 for an individual or $100,000 for a corporate body.

*Repeals and savings*

107.—(1) Subject to this section, the following Acts and item of subsidiary legislation are repealed—

*(a)* the Animals Importation Act (Cap. 159);

*(b)* the Animals (Contagious Diseases) Act (Cap. 160);

*(c)* the Plant Quarantine Act (Cap. 156).

(2) Subsidiary legislation made under the repealed Acts continue in force as if made under this Promulgation until amended, replaced or repealed under this Promulgation, unless and to the extent that –

*(a)* the matter is provided for in this Promulgation;

*(b)* the subsidiary legislation is inconsistent with the provisions of this Promulgation or any other Act.

(3) Provisions of regulations made under the repealed Acts dealing with the treatment of animals, plants and their products on arrival in the Fiji Islands—

*(a)* are deemed to have been made by the Authority as specifications under section 34;

*(b)* may be varied by the Authority under that section;

*(c)* if included in a biosecurity register are governed by section 82 as to their evidential status.

(4) Delegations, directions, notices, agreements and other administrative actions or decisions of the Minister, the Permanent Secretary, the Director of Agriculture and livestock, agricultural and quarantine officers issued or made under the repealed Acts which could be issued or made by equivalent officers under this Promulgation continue to have effect as if issued or made under this Promulgation until varied or revoked under this Promulgation.

*Transitional provisions*

108.—(1) Permits equivalent to import permits issued under any provision of the repealed Laws remain in force until they expire in accordance with their terms, or until revoked under this Promulgation.

(2) Any bond, agreement, instrument or arrangement to which the Government is a party subsisting immediately before the commencement of this Promulgation and relating to the biosecurity functions of the Authority continues to have effect after that date and is enforceable by or against the Authority as if it had been entered into by the Authority under the provisions of this Promulgation.

(3) Subject to subsection (4), any action, arbitration, proceeding or cause of action that relates to a biosecurity function of the Authority and that immediately before the commencement of this Promulgation is pending or existing by, against, or in favour of the Government, or to which the Government is a party, may be continued and enforced by and against the Authority under the provisions of this Promulgation.

(4) A prosecution for an offence committed against a repealed law must be brought and continued under that law.

*Consequential amendments*

109.—(1) A reference in another Act to any of the repealed laws is, to the extent possible, to be read as a reference to this Promulgation.

(2) A reference in another Act to a quarantine officer, plant protection officer or animal health officer is, to the extent possible, to be read as a reference to the CEO or a biosecurity officer exercising equivalent functions under this Promulgation.

*Amendment of Schedules*

110.—(1) The Minister, after consultation with the Authority and the Public Enterprise Minister, may by order amend Schedules 1, 2, 3 and 4.

(2) The Minister may amend column 3, 4 or 5 of Schedule 5 by order, which must be laid before the Cabinet and does not come into effect until it has been passed by affirmative resolution of the Cabinet.

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SCHEDULE 1
*[Section 8]*

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MEMBERSHIP AND PROCEDURES OF THE BOARD

In this Schedule—

"committee" means a committee established under paragraph 13 of Part B;

"member" means a member of the Board other than the CEO;

"Minister" means the Public Enterprise Minister.

PART A — TERMS OF MEMBERSHIP

1. A member holds office for a term not exceeding 3 years and is eligible for reappointment for 3 years at a time.

2. A member may resign from office by giving 30 days notice in writing to the Minister.

3. The Minister may remove a member from the Board if the person—

*(a)* is absent, without leave of the Board, from 3 consecutive meetings of the Board;

*(b)* is declared bankrupt;

*(c)* has, in the Fiji Islands or elsewhere, been convicted of an offence involving dishonesty or carrying a maximum sentence of at least 2 years imprisonment;

*(d)* has, in the Fiji Islands or elsewhere, been disqualified or suspended from practising his or her profession by any competent authority by reason of misconduct;

*(e)* for any reason, is unable to perform his or her functions under this Promulgation.

4. Members of the Board and any committee, and persons invited to attend a meeting of the Board under paragraph 9 of Part B, are entitled to remuneration applicable to boards of commercial statutory authorities appointed under the Public Enterprises Act 1996.

5. A member of the Board or a committee who is, directly or indirectly, interested in a matter under discussion by the Board or committee must disclose to the Board or committee the fact and nature of the interest. This rule applies also to the CEO.

6. A disclosure under paragraph 5 must be recorded in the minutes of the Board or committee.

7. After a disclosure under paragraph 5 the member in question—

*(a)* may not take part in nor be present during any discussion, deliberation or decision of the Board or committee; but

*(b)* may be counted for the purpose of forming a quorum of the Board or committee.

PART B — PROCEDURE OF THE BOARD AND COMMITTEES

1. The Board may act notwithstanding a vacancy in its membership.

2. The validity of any proceedings or act of the Authority or of a committee is not affected by any defect in the appointment of any member.

*Meetings*

3. The Board must meet at least once every 2 months, as determined by the Chairperson, or on a notice signed by at least 3 members.

4. The Chairperson presides at all meetings of the Board, and if he or she is absent, the members present may elect one of them to preside at that meeting [unless a person has been authorised to act as Chairperson under paragraph 3].

5. The quorum at a meeting of the Board is 4 voting members.

6. Notice of a meeting of the Board must be given to each member and delivered by hand or sent by post, telex, facsimile or other written message to an address supplied to the Board for the purpose.

7. Decisions at meetings of the Board are by a simple majority of the members present and voting except that, in the case of an equality of votes, the Chairperson or member presiding has a casting vote as well as an original vote

8. A resolution signed or assented to by letter, facsimile transmission or e-mail message or other means of technology by each member has the same effect as a resolution passed at a meeting of the Board.

9. The Board may invite a person to attend a meeting of the Board to advise it on any matter under discussion, but the person so attending does not have a right to vote at the meeting.

*Seal*

10. The Authority must have a seal of such design as the Board may decide. The seal must be kept by the Chairperson and its affixing is to be authenticated by—

*(a)* any 2 or more persons generally or specifically authorised by Board for the purpose; or

*(b)* one such member and the Chairman.

11. All deeds, documents and other instruments purporting to be sealed with the Authority seal and authenticated in accordance with paragraph 10 are, unless the contrary is proved, presumed to have been validly executed.

12. The Authority seal is to be officially and judicially noticed for all purposes.

*Committees*

13. The Board may establish committees of the Board to advise the Board on such matters as the Board considers necessary.

14. In establishing a committee under paragraph 13, the Board may—

*(a)* appoint such persons, including members of the Board, as it considers necessary; and

*(b)* specify the functions and procedures of the Committee.

15. Persons who are disqualified by this Promulgation from being members of the Authority are also disqualified from being members of a committee.

16. A committee may regulate its own procedure but is subject to this Schedule and to any directions given by the Authority.

17. A committee meets at such times and places as the chairperson may determine.

18. A committee may invite any person to attend any meeting for the purpose of advising it on any matter and a person so invited is not entitled to vote.

*Minutes*

19. The Board and every committee must keep minutes of all its meetings in a proper form.

20. Minutes duly signed by the Chairperson or person presiding are, in any legal proceedings, admissible as evidence of the facts stated in them; and a meeting of the Board or a committee in respect of which minutes have been so signed is deemed to have been duly convened and held and the members present at it to have been duly appointed to act.

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SCHEDULE 2
*[Section 9]*

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REPORTING BY THE AUTHORITY

In this Schedule—

"financial year" means the financial year as defined in Part B of Schedule 3;

"Ministers" means the Minister and the Public Enterprise Minister;

"SCI" means a statement of corporate intent.

PART A — HALF YEARLY AND ANNUAL REPORTS

1. The Authority must give to each of the Ministers a report on its activities for the first half of each financial year, by the end of August or a later date if agreed between the Authority and the Ministers.

2. The half yearly report must include the information required by the Authority s SCI to be given in the report.

3. Within 4 months after the end of each financial year the Authority must in accordance with its statement of corporate intent prepare a report of its activities during that financial year (the "Annual Report").

4. The Authority must send a copy of the Annual Report to the Ministers who must cause it to be laid before the Cabinet as soon as practicable.

5. The Annual Report must contain, among other things—

*(a)* the audited accounts;

*(b)* a statement of financial performance, including a statement of the financial position of the Authority;

*(c)* a statement of cash flows;

*(d)* any other information needed to give a true and fair view of the Authority s financial affairs; and

*(e)* a copy of the auditor s report.

6. The Annual Report must include the information required by the Authority s statement of corporate intent to be given in it.

PART B — CORPORATE PLAN

1. The Authority must in each year publish a corporate plan setting out plans for the future operations of the Authority and must act in accordance with it.

2. The Ministers may issue guidelines as to the format and content of the corporate plan and the Authority must comply with the guidelines except as otherwise agreed in writing by the Ministers.

3. A corporate plan must, except as otherwise agreed in writing by the Ministers, contain—

*(a)* a forecast of profit and loss accounts, balance sheets and cash flows for the current and following 2 financial years; and

*(b)* a statement of the assumptions on which the forecasts are based.

4. The corporate plan must be consistent with the Authority s statement of corporate intent.

*Draft corporate plan*

5. The Authority must, not later than 3 months before the commencement of each financial year, prepare a draft corporate plan.

6. The draft corporate plan must, as soon as possible, be sent to the Ministers, who must within 1 month comment in writing or inform the Authority that the Ministers have no comments.

7. If the Ministers have no comments on the draft corporate plan, the plan is to be treated as approved.

8. If the Ministers comment on the draft corporate plan, the Authority must give effect to the comments in a finalised corporate plan which must within one month be sent to the Ministers for approval.

PART C — STATEMENT OF CORPORATE INTENT

1. The Authority must in each year publish a SCI containing a summary of the corporate plan and setting out the financial and non-financial performance targets of the Authority for that year.

2. In addition to the matters mentioned in paragraph 1, the SCI must include—

*(a)* an outline of the objectives of the Authority;

*(b)* an outline of the nature and scope of the activities proposed to be undertaken by the Authority;

*(c)* an outline of the Authority s main undertakings;

*(d)* an outline of the borrowings made and proposed to be made by the Authority, and the corresponding sources of funds;

*(e)* an outline of the Authority s policies and procedures relating to the acquisition and disposal of major assets;

*(f)* a description of the Authority s accounting policies;

*(g)* a description of the financial information to be given to the Ministers in the half yearly report and Annual Report;

*(h)* a description of measures by which the performance of the Authority can be judged in relation to its objectives, in addition to the performance targets required by paragraph 1;

*(i)* other matters agreed between the Ministers and the Authority or directed by the Ministers to be included in the statement of corporate intent.

3. The Ministers may, in writing, exempt the Authority from including in its statement of corporate intent any matter, or any aspect of a matter, mentioned in paragraph 2.

*Draft SCI*

4. The Authority must, not later than 3 months before the end of each financial year, prepare a draft SCI for the following year.

5. The draft SCI must, as soon as possible, be sent to the Ministers who must, within one month, comment in writing on the draft statement of corporate intent or inform the Authority that they have no comments.

6. If the Ministers have no comments on the draft statement of corporate intent, the statement is to be treated as approved.

7. If the Ministers comment on the draft statement of corporate intent, the Authority must give effect to the comments in a finalised SCI which must within one month be sent to the Ministers for approval.

PART D — GENERAL

1. The corporate plan and SCI come into effect when approved by the Ministers in writing.

2. A corporate plan or SCI may, with the written approval of the Ministers, be modified during the relevant financial year.

3. The Ministers may in writing direct the Authority to modify its corporate plan or statement of corporate intent during the relevant financial year.

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SCHEDULE 3
*[Section 11]*

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EMPLOYEES OF THE AUTHORITY

PART A — TRANSFER

1. At the date of commencement of this Promulgation, persons employed immediately before that date in the Quarantine and Inspection Division whose services are required by the Authority for the performance of its functions under this Promulgation are transferred to the service of the Authority on terms not less favourable than those enjoyed by them immediately prior to their transfer.

2. Until such time as terms and conditions of service, including rules as to the conduct and discipline of its employees, are drawn up by the Authority, the terms and conditions of service of State employees, including rules as to their conduct, continue to apply to every person transferred under subsection (2).

3. A person who is transferred to the service of the Authority is not entitled to claim any benefit on the ground that he or she has been retired from the service of the State on account of abolition or reorganisation of office in consequence of the establishment of the Authority.

4. For the purposes of every enactment, law, award, determination, contract, and agreement relating to the employment of a transferred employee, the contract of employment of that employee is deemed to have been unbroken and the period of service with the State is for all purposes deemed to have been a period of service with the Authority.

PART B — DISCIPLINE AND SURCHARGE

1. The Authority may make regulations with respect to the conduct and discipline of its officers and employees.

2. Regulations made under this Schedule may, amongst other things, provide for—

*(a)* interdiction with reduction in salary or in other remuneration; and

*(b)* suspension without salary or other remuneration, of an officer or employee of the Authority while disciplinary proceedings against the officer or employee are pending.

3. Regulations made under this Schedule must provide for an opportunity to given to the officer or employee concerned to make representations before the Authority makes a decision.

*Surcharge*

4. If—

*(a)* the Authority is satisfied that an officer or employee is responsible—

(i) for the improper payment of moneys or for the payment of moneys which is not duly vouched; or

(ii) for a deficiency in, or the destruction of, moneys, securities, stores or other property of the Authority; and

*(b)* a satisfactory explanation is not given within a period specified by the Authority, the Authority may surcharge against the officer or employee a sum not exceeding the amount of the payment, deficiency or loss, or the value of the property destroyed, as the case may be.

5. If—

*(a)* the Authority is satisfied that an officer or employee—

(i) as an accounting officer, fails or has failed to keep proper accounts or records; or

(ii) has failed to make any payment, or is responsible for any delay in the payment, of moneys from the Authority to any person to whom such payment is due under a contract, agreement or arrangement entered into between that person and the Authority; and

*(b)* a satisfactory explanation is not given within a period specified by the Authority, the Authority may surcharge against the person a sum the Authority thinks fit.

6. Before a surcharge is imposed under paragraph 4 or 5, the officer or employee concerned must be given an opportunity to make representations.

7. The Authority may at any time withdraw a surcharge in respect of which a satisfactory explanation is given or if it otherwise appears that no surcharge should have been made.

8. The amount of any surcharge imposed under paragraph 4 or 5 and not withdrawn under paragraph 7 is a debt due to the Authority from the person on whom it is imposed and may be—

*(a)* sued for and recovered in any court at the suit of the Authority; or

*(b)* recovered by deduction from the salary or pension surcharged by equal monthly instalments not exceeding one quarter of the person s monthly salary or pension.

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## SCHEDULE 4
*[Section 14]*

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### ASSETS AND FINANCES OF THE AUTHORITY

In this Schedule, "Minister" means the Public Enterprise Minister.

### PART A — TRANSFER OF ASSETS

1. On the date of commencement of this Promulgation, all movable property vested in the State immediately before that date and used or managed by the Quarantine and Inspection Division of the Ministry of Agriculture and all assets, interests, rights, privileges, liabilities and obligations of the State relating to that Division are transferred to and vest in the Authority without any conveyance, assignment, or transfer.

2. Every right and liability vested under paragraph 1 in the Authority may, on and after the commencement of this Promulgation, be sued on, recovered or enforced by or against the Authority in its own name and the Authority or the State does not need to give notice to any person whose right or liability is affected by the vesting.

3. On and after the commencement of this Promulgation, any agreement relating to any property, rights and liabilities transferred to and vested in the Authority under paragraph 1 to which the State was a party immediately before the commencement of this Promulgation, whether in writing or not, and whether or not of such a nature that rights and liabilities could be assigned by the State, has effect as if the Authority had been a party to the agreement.

4. If a question arises as to whether any particular property, asset, interest, right, privilege, liability, or obligation has been transferred to or vested in the Authority under paragraph 1, a certificate signed by the Minister is conclusive evidence that the property, asset, interest, right, privilege, liability or obligation was or as not so transferred or vested.

PART B — FINANCIAL MANAGEMENT

1. The Authority must open at one or more banks such accounts as are necessary for the performance of its functions.

2. Money received by the Authority or by any officer or employee on behalf of the Authority must, as soon as practicable after it has been received, be paid into such bank account opened under paragraph 1 as the Authority from time to time determines.

3. The withdrawal or payment of money from an account opened under paragraph 1 must be authorised by prior resolution of the Authority or submitted to the Authority for confirmation in a meeting as soon as practicable after the withdrawal or payment.

4. The withdrawal or payment of money from an account opened under paragraph 1 must be effected only by a person or persons authorised by the Authority.

5. For the purpose of enabling the Authority to carry out its function, the Minister may, from time to time, make grants-in-aid to the Authority of such sums as the Cabinet may determine.

6. The Authority may invest part of its funds in so far as the funds are not required to be expended by the Authority.

7. The Authority may borrow, upon such terms and conditions as the Minister approves, any sums required by the Authority to meet any of its obligations or to perform any of its functions.

8. Borrowings under paragraph 8 require the approval of the Minister, except for overdraft facilities required for working capital purposes.

9. The Authority must conserve its funds by performing its functions and exercising its powers under this Promulgation so as to ensure that the total revenues of the Authority are sufficient to meet all sums properly chargeable to its revenue account including depreciation and interest on capital.

10. The funds of the Authority must be expended for the purposes of -

*(a)* paying any expenditure lawfully incurred by the Authority in the performance of its functions under this Promulgation;

*(b)* discharging any obligations and liabilities of the Authority and making any payments which the Authority is required or authorised to make;

*(c)* generally, paying any expenses for carrying into effect the provisions of this Promulgation.

11. Before giving notice under paragraph 12 the Minister must consult the Authority as to the appropriate amount and be satisfied that the payment will not materially disadvantage any creditor of the Authority or materially impede the Authority in performing its functions or meeting its obligations.

12. The Authority is exempt from stamp duty on all instruments executed by it or on its behalf.

13. The Authority s financial year must be determined by the Board with the approval of the Minister.

14. The accounts of the Authority must be audited each year in accordance with the Audit Act.

SCHEDULE 5

*[Sections 94 and 96]*

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MAXIMUM PENALTIES AND FIXED PENALTIES

| *Item* | *Section* | *Offence* | *Fine $* | *Prison* | *Fixed Penalty $* |
|---|---|---|---|---|---|
| 1. | 11(7)*(a)* | — Officer fail surrender ID | 10,000 | — | — |
| 2. | 11(7)*(b)* | — Forge etc. officer s ID | 40,000 | 12m | --- |
| 3. | 16(2) | — Import prohibited pest/disease | 50,000 | 15m | 1000 |
| 4. | 16(3) | — Import regulated pest/disease | 50,000 | 15m | 1000 |
| 5. | 17(5) | — Import a prohibited article | 50,000 | 15m | 1000 |
| 6. | 17(6) | — Own or possess a prohibited article | 50,000 | 15m | 1000 |
| 7. | 18(2) | — Landing except at point of entry | 50,000 | 15m | 1000 |
| 8. | 18(3) | — Import except at point of entry | 20,000 | 6m | 400 |
| 9. | 18(5) | — Depart except at point of departure | 50,000 | 15m | 1000 |
| 10. | 18(6) | — Export except at point of departure | 20,000 | 6m | 400 |
| 11. | 20(4) | — Interference with holding area | 10,000 | 3m | 200 |
| 12. | 20(6) | — Import without clearanc | 100,000 | 30m | 2000 |
| 13. | 22(3) | — Fail to make arrival declaration | 50,000 | 15m | 1000 |
| 14. | 23(5) | — Fail to comply on arrival | 50,000 | 15m | 1000 |
| 15. | 23(6) | — Master fail to obtain landing clearance | 80,000 | 24m | 1600 |
| 16. | 24(7) | — Crew or passenger unlawful landing | 20,000 | 6m | 400 |
| 17. | 25(2) | — Interference with port quarantine area | 40,000 | 12m | 800 |
| 18. | 25(5) | — Removing a port quarantine notice | 10,000 | 3m | 200 |
| 19. | 26(3) | — Fail to conform to port quarantine | 50,000 | 15m | 1000 |
| 20. | 28(2)*(a)* | — Fail to allow search of vessel/aircraft | 50,000 | 15m | 1000 |
| 21. | 28(2)*(b)* | — Fail comply with request etc. | 50,000 | 15m | 1000 |
| 22. | 29(1)*(a)* | — Fail to secure animal | 40,000 | 24m | 1600 |
| 23. | 29(1)*(b)* | — Fail to secure hatches | 40,000 | 24m | 1600 |
| 24. | 29(2)*(a)* | — Discharge garbage | 60,000 | 18m | 1200 |
| 25. | 29(2)*(b)* | — Discharge ballast/bilge | 100,000 | 30m | 2000 |
| 26. | 29(3) | — Fail to control garbage | 40,000 | 12m | 800 |
| 27. | 29(4) | — Release of ships stores | 40,000 | 12m | 800 |
| 28. | 30(6)*(a)* | — Passenger fail to declare | 10,000 | 3m | 200 |
| 29. | 30(6)*(b)* | — Fail to submit incoming baggage for inspection | 10,000 | 3m | 200 |
| 30. | 30(8) | — Fail to submit outgoing articles for inspection etc. | 10,000 | 3m | 200 |

| | | | | |
|---|---|---|---|---|
| 31. | 31(2) — Fail to make incoming goods available | 10,000 | 3m | 200 |
| 32. | 32(5) — Fail to allow import clearance inspection | 10,000 | 3m | 200 |
| 33. | 38(4) — Fail to surrender revoked permit | 5,000 | --- | 100 |
| 34. | 40(4) — Contravene transit waiver | 20,000 | 6m | 400 |
| 35. | 40(8) — Fail allow inspection in transit | 20,000 | 6m | 400 |
| 36. | 41(2) — Fail to make outgoing goods available | 10,000 | 3m | 200 |
| 37. | 42(2) — Export without clearance | 50,000 | 15m | 1000 |
| 38. | 47(3) — Refusal to move to quarantine | 20,000 | 6m | 400 |
| 39. | 49(3) — Interference with quarantine station | 20,000 | 6m | 400 |
| 40. | 51(4) — Unlawful release from quarantine | 40,000 | 12m | 800 |
| 41. | 52(2) — Removing a quarantine notice | 5,000 | 1m | 100 |
| 42. | 53(3) — Releasing animal etc. | 20,000 | 6m | 400 |
| 43. | 55(6) — Fail to make premises available | 10,000 | 3m | 200 |
| 44. | 57(4) — Fail to open container etc. | 10,000 | 3m | 200 |
| 45. | 59(3) — Refusal to provide samples | 20,000 | 6m | 400 |
| 46. | 65(6) — Person refusing to answer etc. | 10,000 | 3m | 200 |
| 47. | 66(5) — Fail to cooperate with survey | 10,000 | 3m | 200 |
| 48. | 68(5) — Movement in infested controlled area | 40,000 | 12m | 800 |
| 49. | 75(4) — Fail to notify occurrence | 10,000 | 3m | 200 |
| 50. | 79(3) — Breach of emergency directions | 50,000 | 5m | 1000 |
| 51. | 91 — Dereliction of duty by officer | 20,000 | 6m | --- |
| 52. | 92 — Obstruction etc. of an officer | 20,000 | 6m | 400 |
| 53. | 93(1) — Forgery etc. of a document | 40,000 | 12m | --- |
| 54. | 93(2) — Producing a false document | 20,000 | 6m | --- |
| 55. | 93(3) — Using official stamp or seal | 20,000 | 6m | --- |

*Notes:* 1. *The fines and periods of imprisonment are maxima for individuals.*

2. *If the offence is committed by a body corporate, the maximum fine is 5 times that for an individual and there is no imprisonment – see section 97.*

3. *FP means the fixed penalty for the offence under section 96. If no figure is shown, the fixed penalty option is not available. The FP for a body corporate is 5 times that shown.*

4. *The description of the offence in column 3 is for purposes of this Schedule only.*

GIVEN UNDER MY HAND this 17th day of December 2008.

J. I. ULUIVUDA
President of the Republic of the Fiji Islands

INTERIM GOVERNMENT OF THE REPUBLIC OF THE FIJI ISLANDS

BIOSECURITY PROMULGATION 2008

EXPLANATORY MEMORANDUM

*(This memorandum does not form part of the Promulgation but is intended only to indicate its general effect)*

**Background**

Biosecurity means the control of the movement of plants and animals and their products in order to prevent the establishment and spread of animal and plant pests and diseases that can harm human health and the agricultural economy of a country. It involves the control of agricultural and food imports and exports, the establishment of a quarantine regime for animals and plants and the control of the movement of animals and plants within the country.

In many countries in the Pacific region, a review of the plant and animal quarantine laws is long overdue, given the international trend towards freedom of trade and the movement of goods and people. It is also desirable that the laws on biosecurity of the countries of the Pacific Forum be harmonised as far as possible. This Promulgation has therefore been drafted with the assistance of the Secretariat of the Pacific Community, as part of a project that aims to modernize and harmonise biosecurity legislation across the region and bring it into line with international obligations of participating countries.

This Promulgation is intended to replace the Animals Importation Act, the Animals (Contagious Diseases) Act and the Plant Quarantine Act 1982 and regulations made under them. It will bring together laws relating to both animals and plants, and provide the Fiji Islands with a legislative foundation for action to protect it from the introduction of animal and plant pests and diseases. The Promulgation will also enable the country to comply with its obligations to ensure that animal and plant pests or diseases are not exported from the Fiji Islands into neighbouring countries.

**Main features**

The Promulgation establishes a regime to control the import and export of regulated pests and diseases (Parts 2, 3, 4 and 5). It also provides powers to control outbreaks of regulated pests and disease within the Fiji Islands (Parts 8 and 9). The key administrative feature is the establishment of the Biosecurity Authority of the Fiji Islands under Section 8. The Authority will have a Board and be headed by a CEO. It will be staffed by biosecurity officers (Part 10). The Authority members will be appointed by the Minister responsible for Agriculture. The CEO will be appointed by the Board, biosecurity officers and other staff will be appointed by the CEO. The Authority will have the functions set out in Section 9. The powers of biosecurity officers are set out in Part 8. Parts 11, 12 and 13 contain administration, miscellaneous and legal provisions, including enforcement procedures.

A key definition in Section 2 is that of regulated article which includes animals, plants and their products and other articles that pose a biosecurity risk. Under Section 32, incoming regulated articles must not be removed from a biosecurity holding area without biosecurity import clearance, except for having biosecurity measures applied to them. Certain categories of outgoing regulated articles also require biosecurity export clearance – Section 42.

**Contents of the Promulgation**

The scope of the Promulgation is stated in the Long Title.
The Promulgation is divided into 13 Parts, the first of which deals with preliminary matters, including definitions in Section 2.
Sections 3 and 4 make it clear that the Promulgation will apply to everyone in the Fiji Islands, including the Government.
Sections 5 and 6 define the role of the Minister and Board, and Section 7 makes it clear that other obligations relating to bringing in of items into the Fiji Islands are not displaced.

**Part 2** sets out the administrative framework for implementing the Promulgation.
Section 8 establishes the Authority as a body corporate, with details of membership and procedure in Schedule 1.
Section 9 sets out the functions of the Authority, with reporting requirements in Schedule 2.
Sections 10 provides for the appointment of a CEO, and Section 11 provides for the employment of biosecurity officers and other staff, with details in Schedule 3. Section 11 also provides for the designation of biosecurity officers from other departments and can be given specific functions.
Section 12 empowers the Minister to give directions to the Board and the CEO to give directions to biosecurity officers.
Section 13 enables various powers to be delegated, including those of the Board, which can be delegated to the CEO.
Section 14 empowers the Minister to seek additional finance for implementing the Promulgation if necessary, and regulates the financial procedures of the Authority by means of Schedule 4.
Section 15 specifies the destination of fines, fees and charges.

**Part 3** sets out the principles of border biosecurity control. There will be prohibitions and restrictions on the importation of pests and diseases (Section 16).
Importation of any regulated article considered an unacceptable risk to the Fiji Islands will be prohibited (Section 17). The concept of regulated pests and diseases is central to the scheme of the Promulgation.
Points of entry and departure, such as ports, airports and post offices, will be designated and importation or exportation elsewhere will be an offence (Section 18).
Holding areas at ports, airports and post offices will be designated for biosecurity clearance inspection of incoming and outgoing regulated articles (Section 19).
Holding areas will be strictly managed to prevent animals and plants leaving the area until they have been cleared (Section 20).
Importers and exporters of regulated articles must appoint an agent if they will not be present at the time of importation or exportation (Section 21.)

**Part 4** of the Promulgation sets out the rules for incoming and outgoing vessels and aircraft. Every arriving vessel and aircraft must make an arrival declaration on or before arrival (Section 22.)
Vessels and aircraft must obtain landing clearance on arrival (Section 23.)
If ordered into quarantine an incoming vessel or aircraft must proceed to port quarantine (Sections 25 to 27).
It must then obtain quarantine clearance before landing passengers or cargo (Section 28.)
Section 29 requires masters and captains of outgoing vessels and aircraft to cooperate with a biosecurity officer who has reason to suspect that there might be on board uncleared regulated articles that require clearance.
Section 30 imposes on masters and captains of all vessels and aircraft that come into the country obligations with regard to securing the vessel to prevent biosecurity risks. There are also limitations on the discharge of garbage and ballast water from vessels within Fiji Islands waters.
Section 31 sets out the procedure for incoming passengers and crewmembers. They must make a passenger declaration and submit their baggage to inspection. Regulated articles in their baggage will require biosecurity import clearance like any other cargo.

**Part 5** establishes a régime for the control of incoming goods once they have been landed from a vessel or aircraft. All incoming goods will be liable to entry inspection at the point of entry to ascertain whether they are regulated (Section 32).
Incoming regulated articles will require biosecurity import clearance (Section 33). They will be liable to biosecurity inspection at a holding area and their import must be declared.
Section 34 sets out the matters on which a biosecurity officer must be satisfied before biosecurity import clearance can be granted. The requirements may include a sanitary or phytosanitary certificate issued by the country of origin, or treatment of a regulated article on arrival. Biosecurity import clearance will only be granted if all the requirements for import are satisfied, but may be granted conditionally in order to allow the article to be sent for treatment or to quarantine.
The requirements for importing regulated articles will be contained in specifications made by the Authority under Section 35. If there are no specifications relating to a proposed import, the intending importer must apply by way of an access arrangement under Section 36 before importing the article.

If the specifications for an article include the requirement for a biosecurity import permit, it must be obtained in accordance with Sections 37. Section 38 deals with revocation and refusal of a permit.
The Authority will have the power to exempt certain classes of regulated articles from the requirement for an import permit (Section 39).
Articles in transit are governed by Section 40, which enables the requirement for a permit to be waived, if there is no biosecurity threat to the Fiji Islands.

**Part 6** sets out the controls over articles intended for export.
Under Section 41 all outgoing regulated articles are liable to biosecurity export inspection to ascertain whether they require biosecurity export clearance.
Under Section 42, articles will require biosecurity export clearance if a sanitary or phytosanitary certificate is required by the receiving country, or if biosecurity measures need to be applied before the article is exported.
Section 43 sets out how a sanitary or phytosanitary (SPS) certificate can be obtained. It also requires the Director to keep a record of the SPS requirements of receiving countries.
The decision whether additional biosecurity measures need to be applied to an outgoing article will be made by the Authority and contained in specifications under Section 44. The requirement can only relate to animals or plants or their products, not to regulated articles generally, and must be in line with any international obligations of the Fiji Islands.
Once these matters are resolved, Sections 45 and 46 say how biosecurity export clearance can be applied for and obtained for regulated articles that require it.

**Part 7** sets out the rules relating to animals, plants or other articles in biosecurity quarantine for observation or treatment.
Section 47 states the general requirement and Section 48 provides for the establishment of biosecurity quarantine stations.
Movement in and management of quarantine stations is controlled (Sections 49 and 50) and items must not be taken out of quarantine until quarantine clearance is granted (Section 51.) Notices must not be removed (Section 52) and imported animals must not be allowed at large without authority (Section 53.)

**Part 8** defines the general powers of biosecurity officers under the Promulgation. Section 54 sets out certain general rules and Section 55 deals with entry and search of premises, and conveyances.
Section 56 regulates the inspection of documents, and Section 57 regulates the inspection of articles.
Under Section 58, biosecurity officers will have power to detain articles for testing and treatment. Testing and taking of samples are governed by Sections 59 and 60.
An article may need to be treated to remove the biosecurity risk, or reconsigned or destroyed because it poses an unacceptable risk; Sections 61, 62 and 63 give the necessary powers.
Section 64 permits the killing of an animal in order to conduct a post mortem examination.
Section 65 defines the powers of biosecurity officers in relation to people.

**Part 9** sets out the powers of the Authority and biosecurity officers to control pests and diseases within the Fiji Islands. Surveys can be conducted (Section 66), and biosecurity officers are given power to enter, search and inspect premises (Section 67.)
Under Section 68 an officer may order animals to be penned for testing and under Section 69 animals and plants may be treated and destroyed if necessary. Compensation will be payable when such action is necessary. Section 74 enables wild animals to be destroyed if they pose a biosecurity threat.
The Part provides for areas to be declared biosecurity controlled areas, with restrictions imposed over the movement into and out of such areas.
Sections 70 and 71 deal with infested controlled areas, and Section 72 and 73 deal with pest-free controlled areas.
Under Section 75, all persons in the Fiji Islands will have a duty to report an outbreak of certain pests and diseases.
Under Section 76, the Minister will have the power to authorise the release of biological control agents in order to control or eradicate pests and diseases.

**Part 10** provides powers to deal with biosecurity emergencies in the Fiji Islands which cannot be dealt with under Part 9.
If an emergency is declared under Section 77, the Authority is given extensive powers to deal with the emergency, if necessary with the assistance of the police and other Government personnel (Sections 78 and 79.).
Special regulations can be promulgated under Section 80 to give additional powers to the Authority and other persons. These regulations would only remain in force for as long as the emergency lasts.

**Part 11** sets out some ancillary administrative provisions needed to allow the Promulgation to function effectively.
Section 81 requires the Authority to keep extensive registers of all biosecurity decisions and activities. Under Section 82, entries in a register will be admissible as evidence in court.
Section 83 requires the Minister and Authority to consult other Government departments, and empowers the Authority to outsource aspects of biosecurity work if needed. Section 84 seeks to encourage coordination between different departments of the Government. and other statutory authorities on biosecurity matters.
Section 85 requires operators of points of entry and departure (i.e. seaports, airports and post offices) to provide facilities for biosecurity inspection or incoming and outgoing articles. Section 86 requires owners of ships and aircraft and warehouses to ensure that biosecurity officers have safe transport and adequate accommodation for performing their inspection functions.
The Part provides mechanisms to facilitate the biosecurity inspection process.
Under Section 87 the Authority can enter into compliance agreements with persons who regularly import or export regulated articles; and under Section 88, private premises can be approved as places for the inspection and treatment of regulated articles.
The Part also provides for cooperation with the international community in international activities in the field of biosecurity.
Under Section 89, the Minister can enter into bilateral or multilateral agreements on biosecurity matters; under Section 90, the Minister may issue international advisory notices about the status of pests and diseases in the Fiji islands.

**Part 12** is concerned with enforcement of the Promulgation and specifies offences and penalties.
Section 91 creates the offence of dereliction of duty by biosecurity officers.
Sections 92 and 93 create various ancillary offences that might be committed by importers and passengers relating to information, documents etc.
Section 94 prescribes the maximum penalties for all the offences in the Promulgation. These are listed in Schedule 5. Corporations will not be liable to imprisonment but will be liable to higher penalties (Section 97 and 94(3)).
Section 95 provides for forfeiture of items connected with the commission of offences.
Section 96 establishes a system of fixed penalties, to simplify the processing of offences at the port and airport and limit the number of matters ending up in court.
Section 97 specifies higher maximum penalties for corporate bodies.

**Part 13** contains a number of miscellaneous provisions for implementing the Promulgation.
Section 98 extends the jurisdiction of the Magistrates Court to deal with offences under the Promulgation and enables the Authority to take cases to court.
Section 99 says how abandoned goods will be dealt with.
Section 100 says how compensation, if provided for, will be calculated.
Section 101 says how appeals from decisions made under the Promulgation are to be dealt with.
Section 102 says that public officers taking action under the Promulgation in good faith are not liable, and the Government and Authority are not liable for things done under the Promulgation except as provided.
Section 103 provides for the evidentiary status of certificates and other documents created or used under the Promulgation.
Section 104 states the rules about publication of regulations and orders made under the Promulgation; they should be given wide publicity in the areas affected by them, and must also be published in the Gazette.
Section 105 defines the status of specifications made by the Authority; they are not strictly legislative but must be entered in the biosecurity register and given due publicity.
Section 106 enables the Minister and Authority to make regulations to supplement the provisions of the Promulgation. The Authority regulations can include fees and charges for biosecurity services.

Section 107 provides for the repeal of the Animals Importation Act, the Animals (Contagious Diseases) Act and the Plant Quarantine Act 1982 and makes savings in respect of certain provisions.
Section 108 makes transitional provisions for the smooth introduction of the Promulgation, and Section 109 makes consequential amendments to other laws as a result of the enactment of the Bill.
Section 110 provides that Schedules 1 to 4 can be amended by the Minister by Order. Schedule 5 can be amended by Order of the Minister but only with the approval of the Cabinet.

**Schedule 1** sets out the terms of membership of the Board of the Authority and procedures for the Board and committees.

**Schedule 2** says what reports the Authority must provide to the Ministers each year, including a corporate plan and a statement of corporate intent under the Public Enterprise Act.

**Schedule 3** provides for transfer of existing staff of the Quarantine and Inspection Division, and gives the Authority disciplinary powers over employees.

**Schedule 4** transfers the assets of the Quarantine and Inspection Division to the Authority and says how assets and moneys are to be accounted for.

**Schedule 5** lists all the sections which create offences and sets out the respective maximum fines and terms of imprisonment that can be imposed for them. It also sets out the fixed penalty for those offences that can be dealt with by way of fixed penalty under Section 96.

**LAWS OF FIJI**
Rev. Edition 1985]
**APPENDIX 9**

# IRRIGATION ACT

*Act No. 32 of 1973,*
*Legal Notice No. 90 of 1979*

**AN ACT TO MAKE PROVISION FOR LAND IRRIGATION AND MATTERS INCIDENTAL THERETO**

[28 January 1974]

*Short title*

**1.** This Act may be cited as the Irrigation Act.

*Interpretation*

**2.** In this Act, unless the context otherwise requires-

"Commissioner" means the Commissioner for Irrigation appointed under the provisions of section **3**;

"field" means a unit portion of land for which the separate provision of irrigation water is made;

"field bund" means a bank constructed for the purpose of retaining water on or excluding water from a field;

"field channel" means a channel constructed or provided for the purpose of supplying irrigation water directly to fields;

"field drain" means a drain constructed or provided for the purpose of removing drainage water from not more than 3 fields;

"irrigation" means the practice of causing water to flow upon or spread over or under the surface of land or of retaining water on or under the surface of land for agricultural purposes, and includes the draining of land for the removal of water which is injurious to or in excess of the requirements of agriculture;

"irrigation area" means an area declared to be an irrigation area under the provisions of section **5**;

"irrigation water" means water which is put on to or retained on land by means of irrigation works, and includes water reaching such land as rainfall;

"irrigation works" includes headwork buildings, pumps, canals, channels, banks, bunds, bridges, culverts, regulators, sluices, falls, gauges and other similar works used in connection with irrigation, and includes works in connection with drainage and any works for the prevention or mitigation of flooding or erosion to which the land is subject;

"occupier" includes the lessee during the currency of a registered lease, and any person having a right to, or licence or concession over, or permission to occupy, any land;

"officer in charge" means an officer appointed under the provisions of section **6**;

"owner" means the registered proprietor of any land and, in the case of land registered in the Register of Native Lands, means the native owners and, in the case of Crown Land, means the Director of Lands and Surveyor-General*;
**See Legal Notice No. 60 of 1978.*

"pollute" means, in relation to irrigation works, to render such works capable of causing or to cause any water contained in or flowing in or through such works to become unfit or less fit for the purposes of irrigation or prejudicial to the health of any person or offensive in odor or appearance or toxic to any animal.

*Commissioner*

**3.**-(1) The Minister shall, for the purposes of this Act, appoint a Commissioner for Irrigation and may appoint more than one such Commissioner.

(2) If more than one Commissioner is appointed under the provisions of this section, the Minister shall define the area or areas for which each Commissioner has been appointed.

(3) The Commissioner shall act in accordance with any directions of the Minister.

*Functions of Commissioner*

**4.** The Commissioner shall-

*(a)* within the area or areas for which he has been appointed, be responsible for the construction, improvement and maintenance of irrigation works and the establishment and administration of irrigated agriculture; and

*(b)* carry out such works and issue such orders concerning irrigation works and irrigation of lands as he deems necessary for the performance of his functions.

*Irrigation area*

**5.** The Commissioner may by notification in the Gazette, and in such other manner as he considers best calculated to bring to the attention of persons living in the area, declare any lands to be an irrigation area and, by such notification, shall define the boundaries of such area:

Provided that no native land shall be included in any such irrigation area without the prior written consent of the Native Land Trust Board.

*Management of irrigation areas*

**6.**-(1) Every irrigation area and the works therein shall be in the charge of an officer appointed for that purpose by the Commissioner.

(2) Such officer shall-

*(a)* carry out such duties in connection with the management of the area as the Commissioner may appoint; and

*(b)* have power to delegate in writing such duties to his assistants, servants and agents, subject to such limitations as the Commissioner may think fit.

*Powers of Commissioner*

**7.** The Commissioner and every officer so authorised by him in writing shall, within his own irrigation area, have power to do all things necessary to carry out his functions under this Act and in particular shall have power-

*(a)* to maintain or improve irrigation works;

*(b)* to construct new irrigation works;

*(c)* to enter contracts in connection with irrigation works;

*(d)* to control livestock so as to prevent damage to irrigation works;

*(e)* to enter at any time, by means of any member, officer, servant or agent, any lands within his irrigation area for the following purposes:

(i) to do all acts necessary to ascertain whether any irrigation measures are necessary or desirable;

(ii) to construct, maintain and improve irrigation works;

(iii) to inspect irrigation works;

(iv) to ascertain whether maintenance or other measures ordered by him have been or are being carried out;

(v) to survey and take levels of any land in an irrigation area;

(vi) to dig and bore in and under the ground;

(vii) to clear, set out and mark the boundaries of any land in connection with irrigation works;

(viii) to prevent or detect the commission of an act constituting an offence under the provisions of this Act;

(ix) to secure the proper control of livestock in an irrigation area:

Provided that no entry shall be made under the provisions of this paragraph to any land within the cartilage of a dwelling house unless reasonable notice has first been given to the occupier.

*(f)* to engage in the cultivation of land, either on his own behalf or in conjunction with other persons or bodies, for the purpose of promoting the adoption of improved agricultural and irrigation practices;

*(g)* to appoint an Advisory Committee or Committees for the purpose of advising him on such matters as he may specify.

*Adjustment of agricultural holdings*

**8.**-(1) The Commissioner shall, within his own irrigation area, and with the approval of the owners and occupiers of such holdings, have power, for the purpose of forming fields of suitable size and shape for irrigation, to combine or subdivide or increase or reduce the size or alter the orientation or boundaries of agricultural holdings:

Provided that such adjustments of holdings shall not, save with the agreement of the owner, have the effect of changing the ownership of any land.

(2) The Commissioner shall submit to the Director of Town and Country Planning a

plan showing the proposed adjustment of holdings and, in carrying out the adjustment, shall take into consideration the objections, if any, of the Director in relation to the proposed adjustment.

(3) The cost of carrying out such alterations in the size or shape of holdings shall be borne by the Commissioner.

(4) Where any land affected by the provisions of subsection (1) is held on a contract of tenancy, the landlord of such land, by agreement with his tenant, shall make such changes in the contract as may be necessitated by the alteration in the size or shape of the holding:

Provided that a tenant whose interest in a holding has been adversely affected by such alteration may, on giving the landlord 6 months notice or such shorter notice as the landlord may accept of his intention so to do, terminate the tenancy on payment of such agreed compensation as the owner and the occupier or, in the absence of such agreement, the Commissioner, shall decide.

(5) The Commissioner shall maintain-

*(a)* plans showing the boundaries of fields formed under the provisions of subsection (1); and

*(b)* a register in which shall be entered the areas of such fields.

(6) On receipt of an application for the subdivision of any land within an irrigation area, the authority empowered to approve such subdivision shall-

*(a)* consult the Commissioner for the irrigation area; and

*(b)* take into consideration any objection of the Commissioner in disposing of the application.

(7) The provisions of this section shall have effect notwithstanding the provisions of the Town Planning Act.

*(Cap. 139)*

*Irrigation rates*

**9.**-(1) The Commissioner may, with the approval of the Minister, by notification in the Gazette, impose upon all or any land within an irrigation area annual rates to be known as irrigation rates:

Provided that no irrigation rates shall be imposed in excess of $20 per hectare for a period of 4 years from the gathering of the first irrigated crop.

*(Amended by Legal Notice 90 of 1979.)*

(2) Any rates imposed under subsection (1) may, at the discretion of the Commissioner, be reduced or remitted, whether prospectively or retrospectively, if he considers it reasonable having regard to the amount of benefit received in respect of any plot from the irrigation works.

(3) Rates shall be payable by the occupier of the land.
(4) Rates, if not paid by the due date, may be recovered by ordinary civil proceedings.

*Payment of rates*

**10.** An irrigation rate shall be payable on such date or dates as shall be notified by the Commissioner in the Gazette.

*Remission of rates*

**11.** Where the full supply of water necessary to the purpose to which the lands are applied has not been available or for any other reason approved by the Commissioner, any officer appointed for this purpose by the Commissioner may reduce the amount of rate payable to such amount as may appear to him to be just.

*Permitted crops in irrigation areas*

**12.** The Commissioner may, by notification in the Gazette, declare that any land in an irrigation area shall be used only for the cultivation of such crops as may be specified in such notification:

Provided that the Commissioner may, in his discretion, upon the application of any owner or occupier of any land, permit other crops to be cultivated or such land to be used for other purposes.

*Carrying out works outside irrigation area*

**13.** If it appears to the Commissioner or to an officer duly authorised by the Commissioner in that behalf that the carrying out of such works outside the boundaries of an irrigation area is necessary for the benefit of the irrigation works, the Commissioner or such officer may, with approval of the owner and occupier, construct, widen, drain or fill up any canal, channel, drain, ditch, pond or swamp.

*Compliance with programmes, practices and standards*

**14.**-(1) The Commissioner may, from time to time, specify engineering and agricultural programmes, practices and standards to be adopted by owners and occupiers of land within an irrigation area.

(2) In the case of failure by an owner or occupier to comply with such programmes, practices or standards, the Commissioner or the officer in charge of the area shall cause to be served upon him a notice-

*(a)* stating the respect in which he has failed to comply with the programmes or practices or standards; and

*(b)* requiring him to remedy such failure to comply within a period to be stated in the notice.

(3) In the case of failure by an owner or occupier to comply with the requirements of a notice served under subsection (2), the Commissioner may withhold the supply of irrigation water from the lands in respect of which the notice has been served until compliance with the requirements of the notice has been made.

*Field channels, field drains and field bunds*

**15.**- (1) The officer in charge of an irrigation area may, by notice in writing, require the owner or occupier of any land within such area to provide to the satisfaction of the officer in charge, either individually or jointly with other owners or occupiers, field channels, field drains and field bunds for the supply, drainage, retention or exclusion of water and, notwithstanding that they may have

been provided by the Commissioner, to maintain and repair such field channels, field drains and field bunds to the satisfaction of the officer in charge:

Provided that no person shall be required under this section to provide or maintain channels, drains or bunds which will not benefit land whereof he is owner or occupier.

(2) Such notice shall require the owner or occupier to take the necessary action within a stated time, which shall not be less than 15 days from the date of the service of the notice.

(3) If default is made in complying with the provisions of such notice, the officer in charge may cause such action to be taken as is required by the notice and may thereafter certify the cost thereof, and thereupon the amount so certified shall be recoverable from the person by whom default was made as aforesaid in ordinary civil proceedings.

*Removal of trees or refuse*

**16.-** (1) The officer in charge of an irrigation area may, by notice in writing to the owner or occupier of any lands within such area-

*(a)* require him-

(i) to clear the banks or sides of any field channel or field drain or such lands of any trees or plants growing thereon; or

(ii) to remove from any of his lands adjoining any irrigation works any growth or refuse likely to harbour vermin;

*(b)* prohibit him from-

(i) planting any trees or plants on the banks or sides of any irrigation works on such lands; or

(ii) depositing on any lands adjoining any irrigation works any refuse likely to damage such works or to harbour vermin.

(2) Such notice shall require the owner or occupier to take the necessary action within a stated time, which shall not be less than 15 days from the date of the service of the notice.

(3) If default is made in complying with the provisions of such notice, the officer in charge may cause such action to be taken as is required by the notice and may thereafter certify the cost thereof, and thereupon the amount so certified shall be recoverable from the person by whom default was made as aforesaid in ordinary civil proceedings.

(4) Where the officer in charge acting under the provisions of this section requires the destruction of or destroys valuable trees or plants he shall, if such trees or plants were not grown in contravention of any order made under the provisions of paragraph *(b)* of subsection (1), pay to the owner or occupier reasonable compensation therefor.

*Power to withhold water*

**17.** The Commissioner may withhold the supply of irrigation water from any lands-

*(a)* in respect of which the payment of irrigation rate is in arrears; or

*(b)* the owner or occupier of which has-

(i) failed to comply with the requirements of a notice under section **14** or **15**; or

(ii) persisted in the infringement of any of the provisions of this Act, and the irrigation rate payable upon such lands shall be payable notwithstanding such withholding of supply of water.

*Damage to irrigation works by fire*

**18.** In any case in which damage is done to any irrigation works by fire originating on adjoining or neighboring lands, the cost of repairing such damage may be recovered from the owner or occupier of such lands by the officer in charge of such works by suit in any court of competent jurisdiction.

*Obstruction or damage*

**19.** Any person who-

*(a)* wilfully or maliciously blocks up or obstructs or causes to be in any way blocked up or obstructed; or

*(b)* breaches or cuts through or causes to be breached or cut through, any irrigation works shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 6 months or to a fine not exceeding $200, or to both such imprisonment and fine.

*Waste or wrongful use of water by any person*

**20.** Any person who-

*(a)* wilfully causes waste of water supplied by an irrigation works; or

*(b)* not being entitled to the use of such water, wrongfully draws off or causes to be drawn off or converts to his own use any such water; or

*(c)* uses or causes to be used any such water for a purpose other than that for which it is supplied, shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 6 months or to a fine not exceeding $200, or to both such imprisonment and fine.

*Waste or wrongful use of water by owner or occupier*

**21.** If the owner or occupier of any land irrigated by any irrigation works-

*(a)* suffers or permits water obtained from such works or from any watercourse or channel connected therewith to run to waste on his land; or

*(b)* obtains water for such land from such works, watercourse or channel in a manner or for a purpose not authorised by the officer in charge of such works, he shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 6 months or to a fine not exceeding $200, or to both such imprisonment and fine.

*Refusal to allow passage of water*

**22.** Any owner or occupier or other person who prevents or obstructs the passage of water in any irrigation works shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 6 months or to a fine not exceeding $200, or to both such imprisonment and fine.

*Construction of unauthorized waterways*

**23.** Any person who-

*(a)* constructs any canal, watercourse, drain, ditch or pond; or

*(b)* deepens or enlarges any existing canal, watercourse, drain, ditch or pond, within any irrigation area without having previously obtained the consent thereto in writing of the officer in charge of such area shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 6 months or to a fine not exceeding $200, or to both such imprisonment and fine:

Provided that nothing in this section shall apply to any watercourse, drain or ditch in any land within the curtilage of a dwelling house where such watercourse, drain or ditch is not connected to any irrigation works.

*Allowing animals to stray*

**24.** Any person who allows any animal to stray upon the banks or sides of any irrigation works shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 3 months or to a fine not exceeding $100, or to both such imprisonment and fine.

*Unauthorised use of vehicles and boats*

**25.** Any person who-

*(a)* drives, draws or pushes or causes to be driven, drawn or pushed any vehicle along the banks or sides of; or

*(b)* uses or causes to be used any boat, vessel or raft or floats or causes to be floated any wood or other material on, any irrigation channel or other works without having previously obtained the consent thereto in writing of the officer-in-charge shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 3 months or to a fine not exceeding $100, or to both such imprisonment and fine.

*Pollution of Water*

**26.** Any person who washes articles in or otherwise pollutes or causes to be polluted any irrigation works shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 6 months or to a fine not exceeding $200, or to both such imprisonment and fine:

Provided that the Commissioner may, by order published in the Gazette, declare that the provisions of this section shall not apply in any irrigation area to any works specified in such order.

*Tampering with irrigation areas*

**27.-** (1) Any person who, without authority from the officer-in-charge, opens or closes or otherwise tampers with any sluice, water gate, regulator, pipe, bench mark,

water gauge or irrigation works within an irrigation area shall be guilty of an offence and shall be liable, on conviction, to imprisonment for a period not exceeding 6 months or to a fine not exceeding $200, or to both such imprisonment and fine.

(2) Where, by reason of any irrigation works having been so tampered with, the land of any person is benefited, the onus of proving that he did not so tamper therewith or cause them to be tampered with shall lie on such person.

*Appeals*

**28.**- (1) Any person aggrieved by any decision of or any requirement made by the officer-in-charge of an irrigation area under this Act may, within one month of his being notified thereof, appeal to the Commissioner.

(2) Any person aggrieved by any decision of or any requirement made by the Commissioner under this Act may, within one month of his being notified thereof, appeal to the Minister.

(3) Every appeal shall state the interest of the appellant the subject and grounds of appeal.

*Regulations*

**29.** The Minister may make regulations for the encouragement and extension of cultivation in all or any irrigation area and for any other purpose consistent with the provisions of this Act and, in particular, and without prejudice to the generality of the foregoing, to provide for-

*(a)* the constitution of Advisory Committees;

*(b)* compliance with engineering and agricultural programmes, practices and standards;

*(c)* the fixing of rates and charges for development, operation and maintenance of irrigation works;

*(d)* the marketing of produce of crops grown in irrigation areas.

*Protection from deprivation of property*

**30.** When the Commissioner exercises any of his powers under this Act involving the taking possession of or compulsory acquisition of any interest in or right over land, the following provisions shall apply:-

*(a)* the Commissioner shall give reasonable notice of his intention to exercise such powers to the owner or occupier of the land or any person having any other interest or right therein that would be affected by the exercise of such powers;

*(b)* the Commissioner shall apply to the Supreme Court for an order authorizing the exercise of such powers or, if such powers have been exercised, he shall apply to the Supreme Court for an order in that behalf within 30 days of the exercise of such powers;

*(c)* the Supreme Court shall not grant such an order unless it is satisfied that the exercise of such powers is necessary or expedient in the public interest;

*(d)* the Commissioner shall pay damages to any owner or occupier or any person having any other interest or right therein that would be affected by the exercise

of such powers where he has exercised such powers prior to his application to the Supreme Court, when such an order is not granted and he shall promptly pay adequate compensation for the exercise of such powers when such an order is granted;

*(e)* where no agreement as to amount and manner of payment of compensation has been concluded with any claimant to any compensation within 30 days of the grant of the order referred to in paragraph *(b)*, the Commissioner shall apply to the Supreme Court for the determination of those matters in relation to that claimant (including, where necessary, any question as to his entitlement to compensation);

*(f)* the Commissioner shall pay the costs reasonably incurred by any other party in connection with the proceedings before the Supreme Court for any of the aforesaid purposes, including any appeal (not made unreasonably or frivolously) from any decision of that Court.

*Other written law relating to water rights*

**31.** The provisions of the Drainage Act and the exercise of rights over water granted by or under any other written law shall, in an irrigation area, be subject to the provisions of this Act.

*(Cap. 143.)*

*Controlled by Ministry of Primary Industries*

## IRRIGATION

## SECTION 5 - DECLARATION OF IRRIGATION AREAS

The following lands have been declared to be irrigation areas:-

*Legal Notice No. 194 of 1977*

### 1. NAUSORI IRRIGATION AREA

All that area of Crown Land situated north of the Town of Nausori in the Tikina of Bau in the province of Tailevu, being parts of lands known as Verata, Naitukulawau and Nausori and bounded generally on the north by part of the northern boundary of the land contained in Crown Grant 356 and known as Verata, on the east by the main Drainage Canal; realigned Waidamu Creek of the Rewa Rice Scheme, on the south by part of the southern boundaries of land contained in Native Grant 108 and known as Naitukulawau and by part of the southern boundary of Crown Grant 506 known as Nausori, and on the west partly by the eastern boundary of Crown Lease No. 1766 and partly by the alignment of old Colonial Sugar Refining Company Limited Railway Track.

The area is more particularly known edged red on the plan PP 153 kept in the office of the Permanent Secretary for Lands and Mineral Resources, Suva and copies are available for viewing in the offices of the Permanent Secretary for Agriculture and Fisheries, the Commissioner for Irrigation for Central and Western Divisions, the Farm Manager, Nausori Irrigation Project and the Commissioner for Central Division.

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*Legal Notice No. 73 of 1978*

### 2. NAVUA CENTRAL IRRIGATION AREA

All that area of native land situated on the north of Sadro and Vunibau villages in the Tikina of Serua in the Province of Serua and lying on the right bank of the Navua River near its estuary and bounded generally on the north by the part of the southern boundary of Crown Grant 277 known as Tamanoa, on the east by part of right bank of the Navua River, on the south by the part of the Vunibau Feeder Road and on the west by part of Sadro Road.

The area is more particularly shown edged red on the PP 171 kept in the office of the Director of Lands, Suva and copies are available for viewing in the offices of the Permanent Secretary for Agriculture and Fisheries, the Commissioner of Irrigation Central Division, the Commissioner Central Division and the District Officer, Navua, the Farm Manager, Navua Irrigation Project.

*Controlled by Ministry of Primary Industries*

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APPENDIX 10

# MARKET OPPORTUNITIES OF AGRICULTURAL PRODUCTS

MARKET INFORMATION

Introduction

Poultry
Dairy
Pig
Beef
Root Crops
Vegetables
Rice
Ginger
Fruits

## INTRODUCTION

Farm produce may be sold for processing or for direct consumption. There are three main market segments involved in marketing of Agricultural produce in Fiji. These are;

1. Export
2. Local institutions
3. Local consumers

*Export Market*

Fiji's agricultural exports grew notably over the years together with the number of commodity access to the export market. However, this market segment has specific requirements for timing of supply, quality of produce, grading, packaging and presentation of produce. These requirements are rather stringent as compared to other market segments and vary between Fiji's exports destinations. Currently, Fiji's main export markets are New Zealand, Australia, USA and Canada while others such as the Netherlands, Germany Hong Kong and the neighbouring Pacific Island countries absorb a small proportion of Fiji's export.

According to the Biosecurity of Fiji, over 50 commodities have market access to the New Zealand and Australian markets while the US market has 39. In the non-sugar sector, Dalo, Cassava, Ginger, Papaya, and vegetables are the main export commodities from Fiji. Fiji dominated the New Zealand and Australian market for Dalo; however, it faces great competition from the Asian markets that have shown consistency in supply.

*Major Export Markets*

It is estimated that, since independence, 150,000 Fijians have migrated to Australia, New Zealand and Canada . These people maintain a strong demand for products from "home". The large and increasing Asian and Pacific Island population also offers a significant market for many of these products. The vast majority of these people live in the Auckland area. Sydney and Melbourne have a similar demographic composition with a total population of some 15 million. Hence demand for the our export.

Nadi airport is a hub for international air traffic. However, substantial growth will depend on a significant increase in the number of wide-bodied flights out of Nadi. Thus the future market opportunities for horticultural exports depend on the fortunes of the tourism industry.

The sea transit times for Auckland port in New Zealand are 4 to 6 days and for Australian ports 10 to 16 days (approximately 2-3 weeks). This makes regular fresh produce sea freight exports to New Zealand and Australia feasible, allowing suppliers to refurbish stock on weekly basis. This compares with 21 to 30 days for North American and Asian ports and 45 days for European ports.



"The emergence of an Indo-Fijian transitional community" 2002 Carmen Voigt – Graf in R. Iredale, C Hawksey and S Castles. Migration in the Asia Pacific Region: Population Settlement and Settlement Issues. Edward Elgar.

Sea freight rates have increased significantly over the last few years. However, these increases have been proportionately less than the increases in airfreight rates. Current sea freight costs are as follows;

Sea freight to New Zealand

- 4-6 days to reach Auckland
- 20ft dry container cost around $4000FJD
- 20ft frozen container costs around $4680FJD

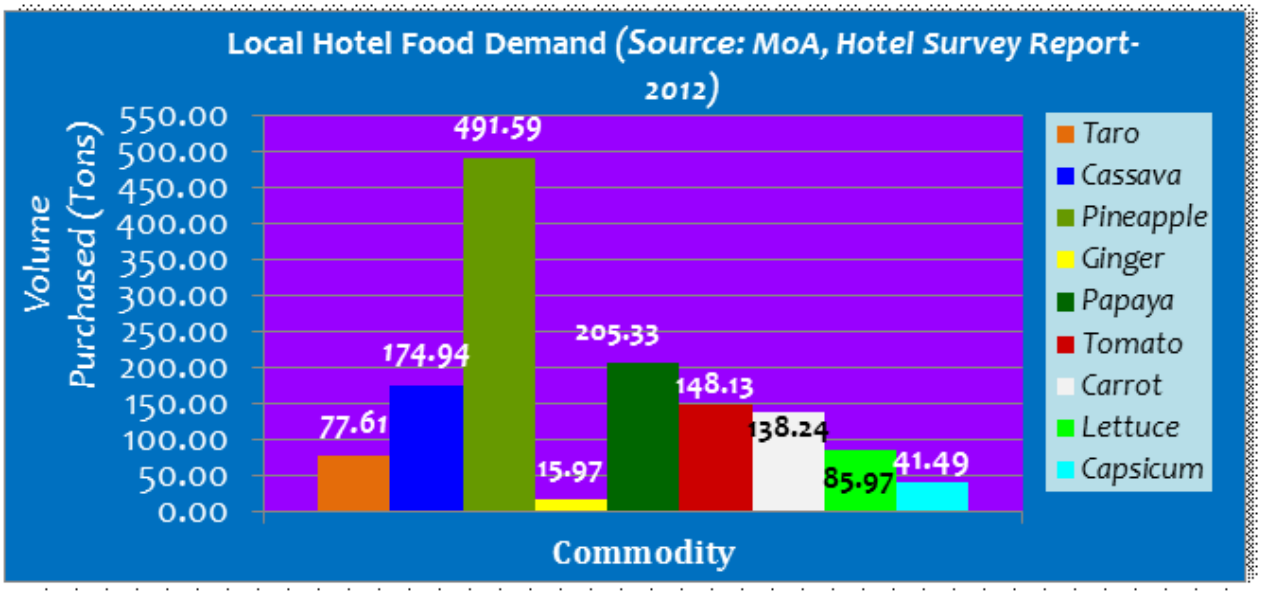
Sea freight to Australia

- 2-3 weeks by sea to reach Sydney
- 20ft dry container cost around $2723.26FJD
- 20ft frozen container cost around 4068.60FJD

*Local Institutions*

Local institutions consist of hospitals, educational hostels and hotels. Supply to these outlets is usually provided by the National Marketing Authority (AMA) and local wholesaler.

The tourism sector in Fiji has been growing strongly over the last few decades, creating a huge potential for the domestic market. The Bureau of Statistics, 2011, revealed that the peak visiting period in Fiji in 2009-2011 was recorded from June to January. This also coincides with the Ministry of Agriculture supply calendar which showing high supply of local fruits and vegetables during the same period.




The illustration above highlights the estimate demand levels for the various commodities by the hotel industry. The information was obtained from the hotel food demand survey conducted in 2012 to identify the demand levels and ascertain the percentage supplied between the local producers and importers on some of these commodities. Taro, Cassava, Pineapple, Ginger and Papaya is dominated by local suppliers while Carrot observed a 100% import. Pineapple experienced the highest demand level by the hotel industry absorbing over 491 tonnes from the local suppliers.

*Local municipal Markets*

This market segment absorbed a huge proportion of produce as compared to other market segments. According to the Agro Exporters Demand survey carried out in 2013 by the Ministry of Agriculture, majority of our local produce are consumed locally when comparing the level of production and volume absorb by the export market. Supply is normally by direct sales to consumers or through middlemen at the local municipal markets, farm gate

or roadside stalls, etc.

There are eleven (11) major municipal markets around the country with two minor centres. The current rural-urban drift also shows an increase in road side stalls situated along the densely populated areas.

Presented below is a summary of the various sectors showing their market the different market segment and their market arrangement.

**POULTRY**

The poultry industry enterprise is of two categories-eggs & meat production. The commercial poultry sector is currently fully integrated and their production is geared towards frozen chickens and table eggs for public consumption. Self-sufficiency eggs and meat has reached 100% and 90.80% respectively (2010 MoA, Annual report). The chain begins from the hatchery with the production of day old chicks with feed being produced from the commercial feed mill, rearing of broilers/pullets for production, and slaughtering/ processing facilities.

*The Poultry Industry*

The local poultry industry is divided into two major sectors; these are the formal and informal sectors. The formal sector consists of commercial poultry players such Goodman Fielder Rooster Poultry Toa Fiji and Ram Sami while the informal sector comprises the subsistence farmers.

*Meat chicken*

The local meat industry produced 17,321.20t (2010) of dressed poultry to maintain 90.80% self-sufficiency. Goodman Fielder and Rooster Poultry controls around 70% and 20% and the remaining 10% is controlled by other private broiler farmers with rural abattoirs and the overseas suppliers.

The reduction in duty by government on raw feed materials and day old chicks would result in cheaper feed and a drop in price of frozen chicken.

*Egg Production*

Individual operators market their own eggs. Larger producers wholesale eggs to large supermarket, hotels and restaurants whereas smaller producers sell directly to consumers at farm gate or through urban market centres. The formal edible egg sector is dominated Ram Sami and Sons who control some 65% of the market share and the other 35% by other commercial layer farms who have an average of 10,000 layer birds

**DAIRY**

Dairy is one the major industry in Fiji. The 2009 Agricultural Census recorded a total 22,551 dairy cattle with approximately 70% of the total of 1,126 farms involved in commercial dairy mainly farming in Central Division. (MoA Census Report, 2009).

Government in the 1960's was determined on a policy of accelerated agricultural development, took several initiatives including improvement in marketing systems, input subsidies, and enlarging support systems. Through these initiatives the dairy industry grew and took over the sugarcane fields leading to the concentration of dairy farming in the Central Division where most farms supply milk to the Rewa Cooperative Dairy Company. In the other parts of the country, farmers deliver milk directly to consumers through the town supply market.

Dairy production in Fiji is undertaken by three different types of farmer:

a) Member of the Fiji Co-operative Dairy Company supplying milk and cream to the Rewa Dairy factory.
b) Registered dairy farmers supply fresh milk to town milk vendors.
c) Farmers keeping one or more cows for milk and ghee.

The Fiji Co-operative Dairy Company (RCDC) continues to be the major buyer of liquid milk and cream.

**BEEF**

Beef production is primarily for local consumption although very small amount were exported to the Pacific countries. Over the years, government led initiative were implemented to develop the beef industry in Fiji in both in large and small scale farms. These include the Verata, Tilivalevu, Uluisavou, Yalavou and Yaqara. The industry is developed in a number of old coconut estates particularly in the Northern Division. However, the bulk of the industry remains firmly in the orbit of culled dairy cows and working bullocks.

A vast amount of imports are used in the canned corned beef market. The tourist industry has highly specific demands for quality and imports whereby only the best quality cuts from prime steers are needed to achieve these demands.

Existing cattle marketing channels are through:

a) The major channel is the individual cattle dealer who travels around in trucks and purchase cattle direct from producers. They are also often described as traditional middlemen because very often they sell cattle direct to the butchers.
b) The large farm often who sell cattle to the butchers e.g. Yaqara, Vatuwiri
c) At farm gate (on hoof)
d) Commercial undertaking-

This is operated by the Ministry of Agriculture on minimal profit basis whereby only transport charges at $0.70 per km is levied to the farmer for marketing butcher stock.

**PIGS**

Pig production has grown steadily over the years, almost consistent with tourist arrivals given the demand and drive from the tourism industry. On average, the Fiji Pig Industry (FPI) produces above 80% of the national demand for commercial pork and pork products (MoA-2012 & FMIB- 2011 Annual reports). This increase is attributed by the demand for processed bacon and ham in the hotel industry which essentially drives the local commercial production. The table below highlights the share of local production to total commercialized pork and pork products from 2006 to 2011 averaged 81%.

| Year | Local Production tonne | Imports tonne | Total Commercial Tonne | % of Local to Total Production |
|---|---|---|---|---|
| 2006 | 911 | 233 | 1,144 | 80% |
| 2007 | 977 | 122 | 1,099 | 89% |
| 2008 | 891 | 299 | 1,190 | 75% |
| 2009 | 946 | 89 | 1,035 | 91% |

| | | | | |
|---|---|---|---|---|
| 2010 | 1168.5 | 124.4 | 1,293 | 85% |
| 2011 | 1180.0 | 673.3 | 1,853 | 80% |
| 2012 | 813.4 | 395.4 | 1,209 | 67% |
| | | | Average | 81% |

*Source: MOA Annual Report 2012, FMIB Annual Report 2011, FAO Stats, Fiji Statistics Bureau*

There are two regional abattoirs in the country. This is controlled by Fiji Meat Industry Board and provides a service kill for wholesales, retailer and processors. The wholesalers, retailers and processors are mainly the butchers such as Fiji Meat Ltd, Leylands, Wahleys, Danny's and the South Pacific Butchers.

**ROOT CROPS**

Dalo and Cassava are the staple root crops produced in Fiji and respectively, are also the leading export commodities in the non-sugar sector. Other Popular root crops such as Yams, Sweet Potato and Tania (Dalo Ni Tana) show small supply level due to the seasonality of these commodities. The marketing of root crops can be done through:

a) farmer's selling directly to consumers through the urban market centres
b) at farm gate to middlemen or exporters
c) Farmers or middlemen to institution, supermarket etc.
d) to exporting companies in the local municipal markets, root crops such as Dalo, Cassava and Sweet potato are commonly sold in baskets and bundles at the local municipal markets but are usually sold on a per unit weight system when to exporters & institutions who buy in bulk.

The New Zealand market for taro is largely confined to the Pacific Island population residing in West and South Auckland as well as the Wellington suburb of Porirua. There are indications of growing market for taro within the Asian community residing in New Zealand. According to 2006 statistics, there are approximately 260,000 Pacific Islanders in New Zealand which account for approximately 7 percent of the total population. This is predicted to reach 480,000 by 2026 at annual growth rate of 2.4 with the main population still primarily based in Auckland.

**RICE**

Rice is currently the major import commodity and around 85% of the total demand is imported. In 2012, import valued around $36 million. Current consumption of rice in Fiji is around 38,000 metric tons valued at 40 million Fiji dollars
The three main marketing channels in Fiji include:

i) the traditional rice produced by small subsistence farmers;
ii) the high yield varieties grown on government supported irrigation schemes, and
iii) the imported white and brown rice.

Fiji currently has got 5 rice milling companies which include Rewa Rice Limited, Visama Rice Mill, Evergreen, Rice Company of Fiji Limited and Punja & Sons (Rice) Ltd. All the listed companies above are only millers. However, the rice company of Fiji and Punja & sons are the only companies which process rice into rice flour and husk as stock feed sold as meal mix.

**Marketing of Traditional Rice**

The low-input traditional varieties were grown by farmers in rain fed areas with harvesting was done by hands. The grains required as family food was stored as paddy on the farm.

Surplus paddy was stored if the facilities permitted or was sold shortly after harvest. Milling was done in small rice mills in the rice growing areas. Traditional rice surplus was either sold to neighbouring or to middlemen and the prices varied according to variety and quality. The prices did not come under price control regulations. Marketing was the best in a local and geographically confined basis. There was no inter-island trade in traditional varieties of rice.

**Marketing for Improved Varieties**

Improved varieties were grown mainly on the three Government-supported irrigation schemes-Navua, Lakena and Dreketi. Farmers sold surplus paddy to Rewa Rice Limited, a government owned company which operates in Nausori and Dreketi. The paddy is delivered to the mill in bags although this result in problems in identifying the moisture content of rice. The prices were determined by Government after the interest of the growers, processors and buying public had been considered.

**Marketing of Imported Rice**

The three major licensed importers of rice in Fiji are Rewa Rice, Punjas & Sons and Visama Rice Limited. There are other small licensed importers. Both brown unpolished rice and white rice are imported. Brown rice is brought from Australia while white rice normally comes from Thailand. The polishing of imported brown rice is done in Nausori, Lautoka and Dreketi.

## VEGETABLES

Fiji produces a wide variety of vegetable and this is attributed by the favourable weather condition. However, Fiji continues to rely on imported vegetables during the off-season (Dec-April), during which local vegetables are often priced in reference to their import equivalence. High value commodities such as Tomato, Capsicum, Lettuce, English cabbage,

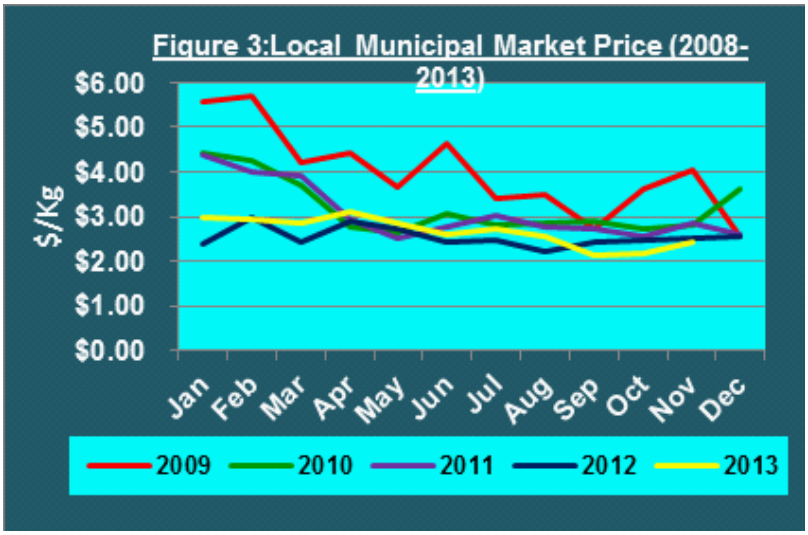
Vegetables may be marketed either:

a) Direct to middlemen, market vendors or exporters at farm gate
b) Direct to hotels& restaurants
c) Direct to consumers through urban market centres

Off- season production will fetch high prices but this requires good husbandry due to high biological risks (pests, diseases) involved.

## GINGER

The industry is characterized by a large number of small holder farms growing ginger in rotation with other root crops (mainly Dalo). The 2012 Ministry of Agriculture annual report 2012 depicted that over 60% of the Ginger produced in Fiji is absorbed by the local market (i.e. local municipal markets, restaurants, hotels, hospitals, boarding schools, etc.) while the other 35% is absorbed by the export market. The basis of the industry is export of fresh and processed products and supply to the local market. The export marketing arrangement for the ginger export more organized as compared to other root crops such as Dalo and Cassava.




**Mature Ginger**

The mature ginger is usually for the fresh export and local market. Contracted farmers supply to their respective companies who then export to the various destinations overseas (U.S.A being the largest buyer).

Immature Ginger

This ginger is mainly processed into brine, syrup and crystallized products for the export market.

Figure 3 depicts the retail prices for Ginger over a 5 year period.

(Source: MoA Municipal market price report)

**FRUITS**

Papaya, Pineapple, Mango, Passion fruit and Citrus are the main fruits considered for commercial development. Papaya is the main export commodity for the fruit basket with New Zealand being the major importer for this commodity. Production for the export market is generally found in the Western division along the the Est and East bank of the Sigatoka river. Planting material for the above fruits is available at government research station

**COPRA**

Coconut (copra) has been a major source of income especially in the maritime zones. According to the Alternative Livelihood report, approximately 60% of production comes from the Northern Division and 40% from the outer lying islands of the Eastern Division. Copra is produced by 3 distinctive groups:

a) Large Growers (>400ha)
b) Medium Estates (100-400ha)
c) Village/smallholder producers.

**Present Marketing Status**

The agriculture sector was subject to a comprehensive review by the ADB in 1996, which was updated in 1999[1]. These studies concluded that Fiji's competitive advantage in agriculture lies in high value, niche market exports and in traditional food production. Since 1996, niche exports and food production have continued to grow, confirming these areas of competitive advantage.

1 Fiji Agricultural Sector Review: A Strategy for Growth and Diversification, Pacific Studies Series. Asian Development Bank, 1996 Republic of Fiji Islands 1999 Economic Report, Asian Development Bank, 2000

While Fiji's traditional commodity sectors - sugar and copra - are struggling, the situation for horticultural export crops is much more encouraging. This entirely small farmer-based sub-sector includes ginger, tropical fruit, root crops and vegetables. This is now, after years of disappointment, the fastest growing part of the agricultural sector. Fruit exports would have been significantly greater had not the Australian market remained closed for quarantine reasons. The continued growth in niche horticultural exports has confirmed the competitive advantage of this area of Fiji's agriculture, although this has not been anywhere near sufficient to offset the demise of the sugar industry.

*Fiji's Strategic Development Plan 2003-2005*[2] *concludes:*
Future potential is with products where Fiji has a competitive advantage such as high value niche exports and traditional food production. Products that give the best returns to labour and land resources include traditional food crops, fresh fruit, processed fruit, processed nuts, cut flowers vegetables, spices, herbs and medicinal plants, handicraft raw materials and certified organic products. (p. 76).

The Strategic Plan's goal for the sector is "Sustainable community development through competitive exports and efficient food security".
Market Opportunities for Cane Areas

The core market opportunities for products from the sugar cane areas are provided by:

- Exporting to the Indo-Fijian, Asian and Pacific Island communities in Auckland, Sydney and Melbourne.
- Enhancing household self-sufficiency.
- Supplying the increasing urban and tourism market.

The Auckland, Sydney and Melbourne Markets

It is estimated that, since independence, 150,000 Indo-Fijians have migrated to Australia, New Zealand and Canada[3]. These people maintain a strong demand for products from "home". The large and increasing Asian and Pacific Island population also offers a significant market for many of these products. According to New Zealand's last population census the Pacific Islander and Asian populations numbered 213,000 (6%) and 175,000 (4.6%) of the total population respectively. The vast majority of these people live in the Auckland area. Sydney and Melbourne have a similar demographic composition with a total population of some 15 million.

Nadi Airport is a hub for international air traffic. The wide-body aircraft that bring the tourists provide the freight capacity for produce exports. Thus it not surprising that the two most important tourist source markets (Australia and New Zealand) offer the greatest capacity for produce freight. The horticultural export industry has been built around this freight capacity. There is some scope for export expansion within existing airline schedules. However, substantial growth will depend on a significant increase in the number of wide-bodied flights out of Nadi. Thus the future market opportunities for horticultural exports depend on the fortunes of the tourism industry.

A more immediate constraint to fresh produce exports by air has been the sharp increase in airfreight rates in recent years, which have undermined the competitiveness of some



2 Strategic Development Plan 2003-2005, Parliamentary Paper No.72 of 2002, Nov 2002. Government of Fiji
3 "The emergence of an Indo-Fijian transitional community" 2002 Carmen Voigt – Graf in R. Iredale, C Hawksey and S Castles. Migration in the Asia Pacific Region: Population Settlement and Settlement Issues. Edward Elgar.

products to some markets[4]. The sea transit times for New Zealand ports are 3 to 6 days and for Australian ports 10 to 16 days. This makes regular fresh produce sea freight exports to New Zealand and Australia feasible, allowing suppliers to refurbish stock on weekly basis. This compares with 21 to 30 days for North American and Asian ports and 45 days for European ports.

Sea freight rates have increased significantly over the last few years. However, these increases have been proportionately less than the increases in airfreight rates.

Current sea freight cost of produce to New Zealand is $F0.17/kg, compared with around $F1.23/kg. Household Food Security

Current airfreight rates are

| Destination | Container type | Cost per container ($F) | $F/kg |
|---|---|---|---|
| Auckland | LD3 (1400kg) | 1,560 | 1.14 |
| | LD8 (2300kg) | 2,370 | 1.03 |
| | LD7 (4300kg) | 3,980 | 0.93 |
| Sydney | LD3 (1400kg) | 1,720 | 1.23 |
| | LD8 (2300kg) | 2,570 | 1.12 |
| | LD7 (4300kg) | 4,300 | 1.00 |
| Los Angeles | LD3 | 5,190 | 3.70 |
| | LD8 | 8,520 | 3.70 |
| | LD7 | 15,920 | 3.70 |
| Tokyo | >1,000 kg | | 4.25 |
| Vancouver | >1,000 kg | | 3.50 |

Source: Fiji Institute of Freight Forwarders and Customs House Agents

Traditionally Fiji's cane farms maintained a high degree of food security. They grew rice and pulses in rotation with cane and met most of the fruit and vegetable needs of the household. Such farming practices have to a large extent disappeared on Viti Levu cane farms, although they still remain reasonably common in parts of the Vanua Levu sector. Overall most farm households now buy most of their food needs.

There is considerable scope for households in the cane areas to re-establish a greater degree of food self-sufficiency and thereby significantly enhancing their livelihood base. In a sense this involves going "back to the future" - albeit with more efficiency through the adoption of improved varieties and practices.

*Increasing Urban Markets*

Fiji is rapidly evolving from an agrarian to a semi urban society. The last population census (1996) showed a population of 772,655. At that time almost half the population lived in urban and peri-urban areas. A decade earlier, less than 40 % of the population lived in urban areas.

This growing urban population offers a substantial basic market for those remaining in farming. Fiji has a low level of self-sufficiency in terms of the production of major food commodities – in 1994 only 39% of energy was derived from local foods[5]. Food imports as a percentage of food exports (including sugar) oscillated between 40 and 60%. This is higher than for most developing countries[6].

**Tourism Markets**

The around 400,000 tourists that visit Fiji annually offer a substantial market for locally grown produce. The 1996 ADB Agricultural Sector Review identified the linkages with tourism as one of the major factors providing Fiji with a competitive advantage to the production of high value horticultural and floriculture products.

**Classification of Market Opportunities**

The market opportunities for the cane areas can be broadly classified into 3 types.

Type 1 opportunities: Existing markets that can be immediately expanded;
Type 2 opportunities: Market opportunities that can be developed in a short period;
Type 3 opportunities: Opportunities that could possibly be exploited in the longer term.

*Type 1 Opportunities: Immediate Expansion of Existing Market*

These are products that are already being produced in the sugar cane areas that are significantly under-supplied to identified markets (both export and domestic). These market opportunities are characterized by a marketing structure already in place and with expansion requiring little or no further investment. A more focused research and extension effort and some adjustments to quarantine arrangements are needed to realize type 1 export opportunities. The domestic market opportunities identified could benefit from a more focused extension effort.

**Quarantine Status Assessment**

*Quarantine Treatment*

Most fleshy fruits and vegetables grown in Fiji are regarded as fruit fly host by target importing countries - Australia, New Zealand and the United States. Thus, horticultural exports largely stopped when the chemical ethylene dibromide (EDB) was banned as a quarantine treatment in 1990. Fiji was proactive in addressing this constraint. With assistance from the United States Agency of International Development (USAID) Fiji embarked on an ambitious project to acquire high temperature forced air (HTFA) quarantine treatment technology.

Natures Way Co-operative (NWC) was formed to own and operate the facility on behalf of the industry (exporters and growers). The NWC facility was certified for the export of papaya to New Zealand in 1996. Today, Fiji has a viable quarantine treatment facility and a growing industry in the export of fruit fly host commodities to New Zealand. NWC currently treats over 500 tonnes of produce (papaya, mango, eggplant and bread fruit) annually. This is a viable business not requiring financial assistance from Government. Unfortunately, Fiji's proactive approach to adopting the necessary technology to facilitate the export of fruit host products has not been matched by the regulatory authorities in Australia and the US. The existing HTFA facility has the capacity to handle a five hold increase in throughput. There are both type 1 and type 2 market opportunities available

5 Nutritional Country Profile of Fiji Islands 1999 FAO

6 Overview of global market developments in the post-Uruguay Round period. 1999 Sharma Ramesh FAO Round Table on the Uruguay Round Agreements: Implications for Agriculture and Fisheries in Pacific Island Countries. Auckland.

that fully utilise this capacity.

**Non-fruit Fly Host Products**

New Zealand has adopted a simple protocol that allows certain products to be exported under a non fruit fly host protocol. Currently around 50 tonnes of chillies are exported annually to New Zealand under this protocol. Okra is also regarded as a non-fruit fly host for all markets. The New Zealand non-host methodology is based on an experimental procedure that does not require the prohibitive sampling of large quantities of fruit as would be required by the Australian and United States regulatory authorities for a non-fruit fly host protocol.

**Type 1 Export Opportunities**

*Type 1 export opportunities can be broadly classified as:*

Expanding existing HTFA products to New Zealand (papaya, eggplant, breadfruit from existing trees, mango)
HTFA products permitted for export to Australia (papaya)
Expanding existing non-fruit fly host products that are permitted for export to New Zealand (pineapples, fresh ginger and chillies)
Non-fruit fly host exports permitted to both Australia and New Zealand (okra, green cow peas and pigeon peas)
Root crops (frozen cassava, dalo ni tana (xanthansoma taro), and yams)

These are discussed briefly below and elaborated in detail the Appendix 2 of the mid-term report.[7]

Papaya: The export of HTFA treated papaya has increased steadily since 1996 to reach 173 tonnes in 2002. This is projected by NWC to reach 700 tonnes over the next 5 years. This increase is based on a combination of continued steady growth in the New Zealand market, the re-emergence of the Australian market and the responsiveness of Fiji growers to favourable market conditions.

Australia represents a far larger market than New Zealand for papaya. In 2001, 6,000 tonnes were sold on Sydney's Flemington Markets alone (Sydney Market Reporting Service). During the 1980s Fiji was a significant exporter of papaya to Australia. Exports to Australia ceased in 1992 when EDB was lost as a quarantine treatment. Seven years on the Australian Quarantine Inspection Service (AQIS) finally approved the export of HTFA treated papaya exports from Fiji. Since that time, Australia has made progress in developing it own domestic industry. The appropriate marketing strategy for redeveloping the Australian market would be initially to target the July to September winter window with superior quality fruit. Fortunately, this happens to be Fiji's peak supply period. During this period returns in Australia can be expected to be at least as good as those obtained in New Zealand. Once Fiji papaya is re-established in the market a significant expansion in exports is forecast, with around 350 tonnes projected for 2006. At about that time sales are projected to be equally divided between Australia and New Zealand.

Eggplant: Once considered to be a relatively minor export product, eggplant has become the major horticultural export. Previously, the market for Fiji eggplant was narrow, being principally Auckland in winter when no locally grown eggplant was available. HTFA treatment has greatly enhanced shelf life compared with the previously chemically treated fruit. Eggplant shipments now continue year-round and are distributed throughout New

7 Appendix 2: Sugar, Mid-Term Report, Lincoln International Ltd and Uniquest Pty Ltd, March 2003.

Zealand – resulting in an over 5 fold increase in sales. An annual 5% growth in eggplant shipments to New Zealand is projected (NWC Strategic Plan 2002).

Mango: No growth in mango exports is projected for the next 5 years, due to increasing competition for mango on the New Zealand market. Traditional Fijian pickling and eating varieties that can reach Auckland in October will still find a remunerative market. However, improved variety mangoes shipped at the peak of the Fiji season (November and December) now face stiff competition from Ecuador. The expectation is that in the next few years Australian mangoes will again enter New Zealand, based on an irradiation treatment protocol. These mangoes would be in direct competition with Fiji mangoes.

Breadfruit from existing trees: Exports of HTFA treated breadfruit to New Zealand commenced in October 2001. Five tonnes were exported in 2002. It is projected that a market of about 100 tonnes could be readily developed in New Zealand from existing trees. This projection is based on a combination of indicators: proven suitability to HTFA treatment; existing production base; and, a large New Zealand market already in place.
The ability to take advantage of the existing stock of breadfruit trees is constrained by Fiji's internally imposed quarantine rules. Undertaking an effective bait spray program for scattered breadfruit trees is difficult. This is a strong argument for establishing small breadfruit orchards for export breadfruit production.

Pineapples: A number of products are already exported New Zealand under a non-host protocol and some of these have scope for expansion, including pineapples, okra and fresh ginger. A niche market opportunity for fresh pineapple exports to New Zealand has been identified. In 2002 New Zealand imported 4,200 tonnes of pineapples. This market is overwhelmingly dominated by Dole pineapples from the Philippines, who supply an exclusive importer. Dole pineapples "piggy back" on vessels carrying bananas and thus enjoy favourable freight rates. The exclusive relationship between Dole and their importer, means that the other major produce importers are denied access to pineapples. These companies are anxious to fill this gap in the product line they can offer to customers and thus are looking for a reliable source of good quality pineapples at a reasonable price. The Mid-Term Report marketing appendix estimated the market for Fiji pineapples in New Zealand to be 500 to 600 tonnes.

Okra: Over the last 3 years an average of 40 tonnes of okra has been exported to Australia and New Zealand. Okra is currently the only fleshy vegetable permitted for export to Australia. The overall market for okra in Australia is substantially larger than New Zealand, although there is competition from domestic production in Queensland. The main target market for expanding Fiji okra exports in Australia is in Melbourne with its large Lebanese and Greek communities. A 5 fold increase in orka exports is feasible This requires the adoption of a production system that involves daily harvesting to provide optimum quality.

Ginger: Over the last decade Fiji's share of the New Zealand ginger market has fallen from over 95% to around 25%. Yet, Fiji ginger remains popular amongst the Asian community on account of its greater pungency and favourable price relative to Australian ginger. Importers believe that Fiji's market share could be significantly increased, particularly if rhizome size could be increased. However, due to disease, a significant increase in mature fresh ginger production is not feasible from the traditional ginger growing areas in the Central Division. The cane areas have an excellent opportunity to take up some of this slack. Some the best mature ginger grown in the 2002 season came from the Labasa area. The advantage that these new areas offer is the absence of nematodes and associated fungal diseases. Some 50 to 100 tonnes of ginger from the cane areas could realistically be shipped

to New Zealand.

Chillies: Around 40 tonnes of chillies are exported annually. The two varieties "hot rod" and "red fire" are permitted to be exported to New Zealand in green form under a non-host protocol. The main demand being in the winter window from April to June. More recently approval has been given for red "birds eye" chillies. These pungent chillies are in short supply and command premium prices. An annual market in excess of 100 tonnes would seem a reasonable expectation for these chillies – albeit at a more modest price.

Root Crops: Samoans living in New Zealand, Australia and the United States constitute the major market for root crops. The Samoan community has a very specific requirement for Tausala ni Samoa (colocaisa) variety taro. This taro cannot be successfully grown in the dry or intermediate rainfall zone, unless supplementary irrigation is provided. However, there other root crops that can be successfully grown on some of the sugar lands. There are export markets already in place for these root crops.

Around 1,000 tonnes of frozen cassava is currently exported to Australia and New Zealand. The main customers are Tongans, Fijians and some Asian communities. Export volumes can be substantially increased if there are sufficient supplies of the suitable pink skinned variety available at a reasonable price (not more than 40c/kg farm gate). An international port at Savusavu would significantly enhance the opportunity for Vanua Levu producers.

Xanthansoma taro (dalo ni tanna) grows well in drier conditions. This taro is not consumed by Samoans, but it is popular amongst Tongans, Fijians and some Asian communities. Small quantities are currently shipped by Fiji exporters and there scope for significant expansion.

Yams are the preferred root crop amongst the Tongan community, which number some 40,700 in New Zealand alone. Some exports of yams are ongoing – but they are limited from available supplies from traditional producing areas such as Kadavu which have been in decline. A 10 fold increase in exports would be readily obtainable if supplies were consistently available at a reasonable price. The establishment of the Savusavu port will increase the viability and returns of growing yams for export.

**Type 1 Local Market Opportunities**

There are type 1 domestic market opportunities that could be readily exploit within existing marketing arrangements with little or no additional capital investment. These include:

Re-establishing pulses and rice as part of cropping systems;
Pineapples in the off-season;
Cassava for food; and
Livestock - goats, small-scale poultry.

These are discussed briefly below and elaborated in detail the Appendix 2 of the mid-term report.

Re-establishing pulses and rice: Before the sugar monoculture took hold pulses and rice were part of the rotational pattern for most cane farms. These crops were grown largely for the household self-sufficiency, with a small marketable surplus often being sold. These were economically efficient production systems. A 1998 study[8] estimated that traditional rice production has domestic resource cost ratio (DRC) of around 0.80, indicating a reasonable

8 Import substitution and protection of food industries: The economics of rice production in Fiji. Prasad, Krishna. Planners Regional Workshop on the Importance of Household Food Security in the Pacific Islands, 6-10 July 1998 SPC Nabua

degree of economic efficiency[9]. This compares with an estimated of 1.70 for irrigated rice production systems, indicating a high degree of economic inefficiency.

Some return to these old self-sufficiency cropping systems would contribute significantly to the sustainable livelihood of the household and the economic efficiency of agricultural production. Falling cane prices and uncertainty are likely to be driving forces to greater household self sufficiency. An additional 2,000 tonnes of rice and 1,000 tonnes of pulses grown on cane farms would seem a conservative estimate of the home consumption import substitution opportunity. Around 30,000 tonnes of rice and 8,000 tonnes of pulses are currently being imported annually.

Off-season pineapples: Around 1,000 tonnes of pineapples are produced annually. Virtually all this production is confined to a period between mid November through end of January) when there are often gluts. For the remainder of the year the market is undersupplied. It is projected that a further 1,000 to 1,500 tonnes could be sold if supplies were available for most of the year.

Cassava for food: Amongst the Fijian community cassava is the most frequently consumed staple followed by rice, bread and dalo. According to the 1999 National Agricultural Survey around 300,000 tonnes of cassava are produced annually. This translates to a per capita consumption of around 180 kgs – allowing for a 50% loss factor. Yet the high prices prevailing on municipal markets would suggest that the local cassava market is far from saturated.

Livestock - goats, small-scale poultry

The high price of a number of livestock products which can be produced on a small scale indicate a supply shortage. Apart from land tenure, the main constraints to realising this expansion is the high cost of feed and the increasing incidence of theft and weak law enforcement in rural areas.

**Summary of Type 1 Market Opportunities**

A summary of the approximate magnitude of Type 1 market opportunities is presented in Table 1. The estimates are in terms of what could be achieved within 2 years and what could be achieved within 5 years. It is estimated that almost $F4 million of type 1 market opportunities could be realized within 2 years and $F10 million within 5 years

**Table 1: Summary of the Approximate Magnitude of Type 1 Market Opportunities**

| | Within 2 years | | Within 5 years | |
|---|---|---|---|---|
| | tonnes | Value ($F,000)* | tonnes | Value($F,000)* |
| Exports | | | | |
| Expanding existing HTFA exports to NZ | | | | |
| - Papaya | 250 | 375 | 500 | 750 |
| - Eggplant | 275 | 413 | 320 | 480 |
| - Breadfruit (from existing trees) | 25 | 50 | 100 | 150 |

9 The DRC shows the number of units of domestic currency required to earn a unit of foreign exchange. A DRC of less than unity implies that the industry is efficient and expanding production of this activity will improve efficiency of agriculture in the country under consideration. A DRC of greater than unity implies the industry is inefficient and expanding production will increase inefficiencies in the agricultural sector.

| | | | | |
|---|---|---|---|---|
| Expanding permitted HTFA exports to Aus. | | | | |
| - Papaya | 50 | 75 | 350 | 525 |
| Expanding existing non-fruit fly host products permitted for export to NZ | | | | |
| - Pineapples | 50 | 50 | 600 | 600 |
| - Okra | 25 | 50 | 40 | 80 |
| - Ginger (from cane areas) | 30 | 60 | 100 | 200 |
| - Chillies | 60 | 180 | 100 | 300 |
| Expanding existing non-fruit fly host products permitted to Aust. | | | | |
| - Okra | 25 | 60 | 150 | 360 |
| Root crops from the cane areas | | | | |
| - Frozen cassava | 100 | 200 | 300 | 600 |
| - dalo ni tanna | 50 | 100 | 200 | 400 |
| - yams | 50 | 100 | 300 | 600 |
| Total exports | 990 | 1,713 | 3,060 | 5,045 |
| Domestic | | | | |
| Increased farm household self-sufficiency | | | | |
| - increased rice production for home consumption | 1,000 | 500 | 2,000 | 1,000 |
| - increased pulse production for home consumption | 500 | 250 | 1,000 | 500 |
| Off-season pineapples | 200 | 200 | 1,000 | 1,000 |
| Cassava for food | 1,000 | 400 | 2,000 | 700 |
| Livestock | | | | |
| - goats | 100 | 400 | 300 | 1,200 |
| - small scale poultry | 50 | 200 | 150 | 600 |
| Total domestic | 2,850 | 1,950 | 6,450 | 5,000 |
| GRAND TOTAL | 3,840 | 3,663 | 9,510 | 10,045 |

* Exports are valued at the approximate fob price; while local market products are valued at the approximate wholesale price.

**Type 2 Opportunities:**

*Market Opportunities with Short Term Development*

There are products that are already being produced in the sugar cane areas. Both export and domestic markets have been identified that could be exploited in a relatively short period of 6 months to 2 years if certain constraints and impediments were removed. The marketing structure is usually already in place, although some modest investment might be required. Success in meeting these markets requires a concerted market access effort, particularly on the part of the Quarantine Service, focused extension and applied research.

**Type 2 Export Market Opportunities**

*Type 2 export opportunities can be broadly classified as:*

New HTFA treated products
New non-fruit fly host products
Additional products to New Zealand (pumpkins)
Non-host products to Australia (chillies, pumpkins)
Fresh ginger exports
Certified organic products
Breadfruit as a crop
Medicinal products (kura)
Vanilla

These are discussed briefly below and elaborated in detail the Appendix 2 of the mid-term report.

New HTFA Treated Products: It now seems clear that HTFA will be technically suitable for a whole range of fruits. Fiji now has the opportunity to develop export protocols for bitter gourd, bottle gourd, wi, tomato, lime and passion fruit. Yet only four commodities (papaya, mango, eggplant and breadfruit) have yet to be approved, which represent a considerable waste of this resource. Readily available market opportunities have been identified for a number of other products that would be suitable for HTFA treatment. These can be classified as follows:

Additional products to New Zealand
Additional products to Australia
HTFA products to the United States

Bitter gourd, other gourds, wi, jak fruit, guava, rock melon, and passion fruit are all commodities with good market potential. Confirmatory tests need to be undertaken and the data submitted to the New Zealand authorities, together with an up to date pest list.

It is estimated that 15 tonnes of bitter gourd could be exported. This could jump to 25 tonnes in 2006 with the anticipated entry in to the Australian market. Bottle (lauki) and sponge (loofa) gourd can be expected to follow bitter gourd into New Zealand. It is assumed that these other gourds will have a combined demand that equals that of bitter gourd.

Wi, commonly known as hog plum, popular Pacific islanders. The NWC Strategic Plan projects wi exports to New Zealand to reach 15 tonnes by 2005. Jakfruit is popular for curry. The NWC Strategic Plan projects that 5 tonnes of jakfruit will be treated in 2004, increasing to 15 tonnes by 2006.

With the recent approval by AQIS of HTFA treated papaya, attention now needs to be turned to other HTFA treated commodities for the Australian market. The immediate priorities should be eggplant and breadfruit. Australia has a much larger population, with a similar ethnic composition to New Zealand. Purple varieties are grown in Australia, although they are reported to be different than the Fiji varieties. The NWC Strategic Plan assumes that a small volume of eggplant (50 tonnes) will be shipped to Australia in 2004. Rapid growth is projected to occur in the following years – 85 tonnes in 2005 and 170 tonnes in 2006. The basis for this rapid growth projection is the New Zealand market experience of HTFA treated eggplant. Australia offers similar market potential for breadfruit as New Zealand.

HTFA quarantine treatment technology was developed by the USDA. Thus, it is reasonable to assume that Fiji could secure certification of its HTFA facility for export or transhipment

through the United States. Of the four currently approved commodities for export to New Zealand only eggplant and breadfruit would appear to have market potential in the United States. The Indo Fijian community living in the United States is smaller than that living in Australia and New Zealand - although it would provide similar market opportunities for Fiji eggplant. Breadfruit, however, is considered as potentially a much larger market opportunity, with the large Polynesian population living in California, Hawaii and Utah.

A much larger Indo Fijian community can be found in west coast Canada. This group had in the past been a market of similar size to New Zealand for a wide range of traditional Indo-Fijian products. These products were sent by air, transhipped through Hawaii. However, in 1994 a ban was imposed on all fruit fly products transhipping through Hawaii. The approval by USDA of a HTFA protocol for the transport of fruit fly host through Hawaii to Canada, could be expected to return produce exports to Canada their previous levels. However, high freight rates will pose a constraint.

New Non-fruit fly host products: The most immediate and significant opportunity is for Fiji pumpkin exports to New Zealand. MASLR's Research Division's Fruit Fly Team, have shown Fiji pumpkins to be a non-fruit fly host in accordance with New Zealand's non-host methodology. The initial demand is estimated at around 300 tonnes. Pumpkin grows well in the cane area with little or no inputs.

The Indo-Fijian Community in Australia offers a similar market for chillies and pumpkins as New Zealand. Australia is unlikely to accept these products as a non-fruit fly host as it does not recognise the New Zealand experimental methodology. In addition Fiji will be required to prepare a complete and undated pest risk for these commodities. Under the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (ASPM), Fiji would seem to have a strong case for general acceptance of the New Zealand non-host protocol.

Fresh ginger exports to Japan and Australia: There are market opportunities for fresh ginger in Japan and Australia. However, Fiji is currently excluded from these markets on quarantine grounds. A requirement to export fresh ginger to Japan, is certification that the soil in which the ginger is grown is free of a particular nematode Radopholus simulis. This requirement creates both a constraint and an opportunity. Suitable ginger growing locations in the cane areas have never grown ginger and are likely to meet the Radopholus free requirement.

In Australia there is a market for around 200 to 300 tonnes of Fiji ginger if the removal quarantine barriers can be negotiated. These restrictions are seen as unreasonable given:
Fiji ginger would be sold in southern Australia, thousands of miles from the Australian ginger growing area.
Australia itself has a very unfavourable ginger disease status.
Fiji is permitted to export ginger to Hawaii, which is a major ginger producer.

Certified organic products: There is an opportunity to develop markets based on environmental sustainability, capitalising on the increasing health concerns and environmental awareness of consumers in importing countries. Fiji has a number of distinct advantages in developing certified organic industries:

The general perception of Fiji being a relatively unpolluted and unspoiled environment.
An opportunity to build on, and market, existing traditional and sustainable organic production systems.
High demand for certain products technically feasible to produce organically in Fiji (sugar,

cocoa, fresh and processed fruits, coconut products and spices).

Locally available fertiliser resources (e.g. "mill mud" the residue from the clarifier in sugar processing) to provide sufficient nutrients to organically produce quality products.
A non-chemical quarantine treatment (HTFA) that will allow the export of organic fruit.
Willingness of donors to provide technical assistance to support organic agriculture.

Over the last decade a number of Fiji agribusinesses have obtained organic certification, including spices, fruit purees, cocoa, ginger and kura. The financial and administrative costs of re-certification proved prohibitive for the small business concerned. Thus, only organic fruit puree certification for banana, mango and guava products made by Atys (Fiji) Ltd, formerly South Pacific Foods, has proved sustainable. Atys (Fiji) produces 1,000 to 2,000 tonnes of puree products annually, requiring 2,500 to 3,500 tonnes of raw material. Expanding the products supplied to Atys (Fiji) is the most immediate organic opportunity. TA five fold increase in throughput is feasible if organic supply can be made available.

New Zealand's largest organic distributor, is particularly interested in sourcing organic produce from Fiji. The main interest is for fresh produce that can be supplied during the winter window (April - October). Some immediate organic candidates in New Zealand include: papaya, mango, eggplant, chillie, pumpkin, cucumber, pineapple, okra, beans, fresh and processed ginger and tumeric.

Medicinal products: Kura (Morinda citrifolia) is a medicinal product that offers immediate market opportunities, which has a marketing structure already in place. This market is analysed in detail in the Mid-Term Report, appendix 2. Kura plants can grow well on marginal land and would be well suited to much of the sugar cane growing areas. For new market entrants such as Fiji, Europe probably offers a better market prospect for kura products. However, exports of kura juice to the EU is subject to the Novel Food Regulation (NFR), which requires any food first imported into the EU after 1997 to show that it is not deleterious to heath. These regulations are a blanket response to genetically modified (GM) products entering the market. Acceptance of the kura juice under the NFR would lead to a substantial boost in demand.

Breadfruit as a Crop: The potential market for fresh breadfruit has been conservatively estimated at 1,000 tonnes, starting with New Zealand and expanding to Australia and the United States. However such an industry could not be based on collecting fruit from scattered trees supported by an inefficient bait spraying program. Breadfruit under normal handling is a highly perishable crop and cannot be expected to last more than a few days, which would preclude any significant export development. However, findings from Samoa and the Caribbean show that breadfruit is a surprisingly robust crop can have an extended shelf life if handled correctly.

Vanilla from the cane areas: Fiji currently has a miniscule vanilla industry and is not grown in the cane areas. However, there is no reason why it could not be successfully grown here. The distinct dry season would help induce flowering, which would be assisted by the cooler conditions at higher elevations. The vines would require access to water during prolonged dry periods. Suitable support trees would be required – a radically pruned mango or citrus tree would be ideal. Heavy mulching would be necessary in the drier conditions of the cane areas.

*Type 2 Local Market Opportunities*
Type 2 local opportunities can be broadly classified as:
Increased sales of local produce to the tourism sector

Commercial pulse and grain production
Spices for the local market

It is in these areas that the most significant alternative uses for resources devoted to sugar can be found. These are discussed briefly below and elaborated in detail the Appendix 2 of the mid-term report.

Increased sales of local produce to the tourism sector: While the tourism sector is well short of realising its potential contribution to the agricultural sector, it already buys significant quantities of products such as fruit. Some simple calculations for fruit and flowers show the extent that the tourism market is under-supplied. The hotel market for papaya, mango and pineapples is estimated at 600, 500 and 800 tonnes respectively. These represent substantially larger markets than those expected from exports, at least for the foreseeable future. In the case of flowers, Hawaii provides a guide to the market for flowers that can be generated by a flower orientated tourism industry.

There is also an opportunity for "carry-on" sales to tourists as they leave Fiji. The potential of this opportunity can be gleaned from the Hawaii experience. In 2001 the value of "Hawaii Food Products" sold to departing tourists was $US102 million. In Fiji, apart from some papaya sold to Japanese tourists, very little advantage is taken of the "carry on market".

Commercial pulses for human consumption: Pulses in the form of dhal are a major source of protein. Dhal is now widely consumed by all communities. Around 17,000 tonnes of dried pulses are imported annually. Some 75% comes from Australia in the form of blue peas which are manufactured into slit peas. Pigeon pea, which is agronomically well suited to the cane areas, offers the best opportunity for import substitution. If locally produced dried pigeon peas can be made available to the manufacturers at a significantly lower price than the imported peas from Malawi then substantial substitution could be expected. Pigeon peas are generally considered to produce a superior dhal. There would also be export opportunities given than dhal packaged in Fiji under well known brand names are exported to Australia and New Zealand. There is probably a realistic dried pulse market for 3,000 to 4,000 tonnes of locally produced dhal.

Grain and pulses for livestock feed: Poultry and pork have enjoyed strong growth in recent years despite deregulation. Both industries have approached self-sufficiency in terms of output. However, in contrast to self-sufficiency in output, these industries have remained almost entirely dependent on imported feed inputs. Currently around 20,000 tonnes of feed grain in the form of wheat is currently being imported annually. In addition some 2,000 tonnes of soybean meal is being imported for protein in the feed rations. Maize and sorghum can be substituted for wheat provided it is available in normal times for around $F350 per tonne.

Import substitution spices: A similar, albeit smaller, opportunity exists for the import substitution of spices. Trade Statistics show the value of spice imports in 2001 was $F3.5 million. The spices of most relevance to the cane areas are dried chillies and pepper.

*Summary of Type 2 Market Opportunities*
A summary of the approximate magnitude of Type 2 market opportunities is presented in Table 2. The estimates are in terms of what could be achieved within 5 years. The estimated annual value of type 2 opportunities is $F7million for exports and $F6 million for local markets.
Table 2 : Summary of the Approximate Magnitude of Type 2 Market Opportunities

| | Within 5 years | |
|---|---|---|
| | tonnes | value($F,000)* |
| Exports | | |
| New HTFA treated products to New Zealand | | |
| - Bitter gourd | 25 | 70 |
| - Other gourds | 15 | 40 |
| - Jak fruit | 15 | 40 |
| - Wi | 15 | 30 |
| New HTFA products to Aust. | | |
| - Eggplant | 170 | 300 |
| - Breadfruit | 150 | 300 |
| HTFA treated products to the US and Canada | | |
| - Eggplant | 300 | 600 |
| - Breadfruit | 100 | 200 |
| New non-fruit fly host products to New Zealand | | |
| - Pumpkins | 300 | 400 |
| Fresh ginger exports | | |
| - Japan | 250 | 350 |
| - Australia | 250 | 350 |
| Certified organic products | | |
| - increased fruit puree sales | 1,000 | 1,200 |
| - organic produce to New Zealand | 190 | 475 |
| Medicinal products | | |
| - sales of kura products to Europe | 150 | 1,200 |
| Breadfruit as a crop | 700 | 1,400 |
| Vanilla | 1 | 75 |
| Total exports | 3,621 | 7,030 |
| Domestic | | |
| Increased sales of local produce to the tourism sector | | |
| - tourist consumption in Fiji | 3,000 | 1,000 |
| - "carry-on" sales to tourist | 50 | 300 |
| Commercial pulses and grains | | |
| - pulses for human consumption | 3,000 | 2,100 |
| - grains and pulses for livestock feed | 4,000 | 2,500 |
| Import substitution spices | | |

| | | |
|---|---|---|
| - dried chillies and pepper | 5 | 200 |
| Total domestic | 10,055 | 6,100 |
| GRAND TOTAL | 13,676 | 13,130 |

* Exports are valued at the approximate fob price; while local market products are valued at the approximate wholesale price.

**Type 3 Opportunities:**

Potential Markets in the Longer Term

It is estimated that over the next 5 years, additional markets (type 1 and type 2 opportunities) valued at around $F25 million are readily obtainable (about 10% of the current value of sugar exports). This additional income is entirely based on small holder production, thereby ensuring maximum labour absorption. A number of other significant potential market opportunities can be identified. However, for these there are no marketing structures in place and substantial agribusiness investment is required.

Some examples of these type 3 market opportunities include:

- Larger scale pineapple production (fresh and processed)
- Large scale floriculture
- Neem
- Nuts (cashew nuts, vutukana orchards)
- Industrial hemp
- Stevia

These are discussed briefly below and elaborated in detail the Appendix 2 of the mid-term report.

Large scale pineapple production: Pineapples have on a number occasions, including ADB agriculture reviews, been identified as one of the few crops that could potentially result in significant alternative use of sugar lands. Immediate type 1 and type 2 market opportunities have been identified for pineapples. These take advantage of a niche market in New Zealand (about 600 tonnes) and producing off season pineapples for the local market, particularly for the tourist sector (about 500 tonnes). Taking pineapple sales beyond an additional 1,500 to 2,000 tonnes moves into the realm of a Type 3 marketing opportunity requiring a marketing structure that does not exist and substantial agribusiness investment.

Large scale mango processing: A Type 2 market opportunity has been identified for the processing 200 to 400 mangoes utilising the Atys (Fiji) puree facility at Sigatoka. The International Trade Centre notes a current under-supply of processed mango products - dried, pulp, and minimally processed. However, the realisation of these opportunities can only be forthcoming with substantial agribusiness investment, as was the case with Atys puree processing facility in Sigatoka.

Large scale floriculture:
Fiji has the potential of establishing a substantial world class floriculture industry based on:

- climatic conditions favourable for growing a wide range of tropical flowers and leaves;
- a relatively good pest and disease status;

- a basic production and marketing structure already in place;
- an under supplied tourism based market;
- a strong and growing non-tourist local market;
- a strategic location with respect to markets;
- competitive labour costs; and,
- good air and shipping links.

Locations around Nadi are particularly well suited to floriculture. Despite the potential the present floriculture industry is small. It has a large number of participants - predominately indigenous Fijian women. However, for floriculture to become a major export oriented industry will require substantial agribusiness investment, well beyond the capacity of the present players in the industry.

Neem (Azadirachta indica) trees can be found around homesteads throughout the cane areas and it will grow on the most marginal of land. The neem tree offers great potential for agricultural and industrial exploitation, particularly as a source of an environmentally friendly insecticide. Neem has become the premier insecticide used in organic production systems and it is recognised by all the organic certifying agencies operating in Fiji. Thus, it has a critical role to play in the development of organic agriculture. Beyond simple on farm processing, cottage industry development and as a source of fire wood, there are opportunities for the industrial development of neem products. This would involve farmers growing neem seeds for sale to a processing factory. Such a development awaits the arrival of an agribusiness investor.

Industrial hemp (non-narcotic, low Tetrahydrocannabinoid THC, Cannabis Sativa L) is another crop well suited to marginal land. Hemp is one of the oldest known non-food crops. Traditionally its fibres were used for the manufacture of rope, fabric and paper; its core for fuel; its seeds as a source of protein or oil and its leaf as a supplementary stock feed. The main interest in industrial hemp is to produce usable fibre that can be integrated into the existing garment industry, rather than exporting bulky raw material. There would be an initial applied research need to test and develop high yielding low THC strains that are high in fibre and that are well suited to Fiji conditions. Any industry development cannot commence until the Dangerous Drugs Act is amended to allow for the cultivation of industrial hemp and the peripheral interest of the private sector is translated into capital investment.

Tree Nuts: There are number of tree nuts that could be successfully grown in the sugar cane areas. Two such opportunities, cashew nuts and vutukana nuts, are examined in the mid term report appendix 2:

Stevia is a plant with carbohydrate-based compounds that are 200-300 times sweeter than sucrose. Expectations are that the crop would grow well in a range of conditions prevailing in the cane areas. The cost of extracting and refining stevia is not available. Thus it is not possible to judge if Fiji could have a comparative advantage in producing the product. However, stevia is an example of the type crop that might be grown in the cane areas if there was substantial agribusiness interest. It also shows the future pressure sugar is likely to face as an international commodity.

Capacity of the sector to take advantage of the identified markets

The mid-term report appendix 2 analysis the sector's capability to take advantage of the markets that have been identified for the sugar cane areas. These findings are summarised briefly below.

Farmers and production systems: In a controlled regulated environment such as growing sugar cane, Fiji farmers have performed well. The performance has not been so satisfactory when it comes to growing newer diversification crops requiring independent managerial skills on the part of the farmer. This is not surprising given generally low level of educational attainment of farmers, which holds back the pace of development. Not only is the entrepreneurial spirit generally lacking for cultural reasons but the ability is also scarce and needs to be nurtured. The closure of the Navuso Young Farmer Training Scheme has left a vacuum in the training of young Fijian farmers in farm management. This has not been filled by the Extension Service. Farmers need to be provided with realistic market and marketing information, including the cost of marketing. Attitudes have to be moved away from selling small quantities at a high price. Farm management extension training needs to focus on increasing farmer income through increased productivity.

Traders and Middlemen: The success of horticulture export sector can be largely attributed to the skill and resiliency of the Fiji produce exporters. The competitiveness of the marketing system is reflected in the relatively narrow marketing margins of exporters and traders. It would be unwise to directly intervene in the produce marketing system, particularly as it is efficient and competitive. However, there are failures in the marketing system in terms of the quality of the produce delivered to consumers, which is to the detriment of the longer-term income of farmers. There are measures that can be taken that will encourage the system to delivery a better quality product, particularly for export markets.

These include:

providing incentives for the widespread adoption of plastic field bins by fruit and vegetable farmers; and mounting intensive training programs in fresh produce quality and handling, in conjunction with Industry Councils.

Government can contribute significantly to the overall performance of exporters by improving the enabling environment under which they operate.

Such measures could include:

- empowering Industry Councils to establish and enforce export quality standards and determine the criteria for issuing export licenses;
- focusing extension and research efforts to ensure supply requirements are met;
- ensuring Quarantine Service gives priority and resources to market access activities and quarantine regulations are enforced without fear or favour;
- providing technical and political support to facilitate market access; .
- providing access to produce exporter friendly, post - export finance schemes; and,
- intervention with Air Pacific to set reasonable freight rates.

Collection Centres operated by a Marketing Authority are not seen as a sustainable viable option. However, there are lower cost alternatives, utilising the private sector.

Urban Markets: There exists an extensive network of outlets for farm produce throughout the urban areas. There has been a steady improvement in the retailing of agricultural produce. However, there is still considerable scope for improvement in quality. For most municipal authorities greater priority is given to "health and safety" regulations than to facilitating the sustainable livelihood opportunities provided by small-scale produce selling.

There are a number of measures that could be taken to improve the operation of urban produce markets. These include:

- provision of shelters for farmers/middlemen who sell outside the market;
- encouraging the use of plastic crates for produce sold on domestic market markets;
- providing post-harvest handling courses to market vendors; and,
- posting price and supply data on Market notice boards for use by vendors/farmers;

Physical Infrastructure: Good quality infrastructure, such as roads, jetties, wharves, airfields, telecommunications, electricity and water supply, is essential for the efficient movement of produce from the farm to the consumer. Public investment in key infrastructure can lead to a major produce marketing response. By the same token, marketing will be seriously constrained, or not occur if key infrastructure is absent, regardless of what other measures are taken.

The only way to export significant volumes of produce at reasonable cost is by sea. Fiji has international standard ports at Suva and Lautoka. However, only Viti Levu grown produce, or produce transhipped to Viti Levu, can take advantage of this favourable export shipping situation. Vanua Levu does not have international standard port facilities to attract export shipping. Thus, despite the considerable production potential of this major sugar producing island is at a significant disadvantage when it comes to exploiting export markets.

The great strides that have been made in telecommunications in recent times are starting to be felt in improved marketing of Fiji's agricultural produce. However, many agricultural areas are still to enjoy the marketing benefits from the telecommunications "revolution". The expansion of the mobile phone network would make a major contribution to produce marketing from remote areas.

Marketing operations requiring the use of coolers and freezers need access to Fiji Electricity Authority (FEA) power if they are to be cost effective and are to operate at an acceptable level of risk.

A systematic infrastructure investment program to facilitate marketing is required, including:

- roads to main production areas;
- improvement of main jetties with adequate shelters for holding produce;
- an international sea going port at Savusavu;
- FEA power in key production areas; and,
- mobile phone coverage to key production areas.

Agricultural Quarantine: The biggest weaknesses are in timely export protocol development and in establishing efficient pest risk assessment mechanisms for importing planting material. Quarantine needs now to be strengthened and re-organised into a modern technically competent service. A program of professional upgrading needs to be initiated as a matter of urgency.

Research: It is necessary to provide adequate support for research programs to enhance quality, reduce marketing cost and face market access. Some priority research areas identified include: taro mites; eggplant thrips; and kava "die back". Funds could be provided to other specialist research organisations to solve specific problems.

Market and marketing information: An efficient marketing system depends on the free flow of accurate information between sellers and buyers. The provision of this market information was one of the main justifications for the creation of Fiji AgTrade in 1996.

Recommendations for AgTrade to improve its efficiency, usefulness and long run sustainability include expanding beyond traditional market information services to providing information that directly links farmers to traders in isolated areas.

Issues to be Addressed

Issues to Realise Type 1 Market Opportunities

Type 1 market opportunities can be readily realised with existing resource availability and marketing structure. Little or no additional capital investment is required. A more focused research and extension effort and some adjustments to quarantine arrangements are needed to realise Type 1 export opportunities. The domestic market opportunities identified could benefit from a more focused extension effort.

More focused research and extension: Some of the inability to satisfy existing available export markets can be traced to the lack of focus in the research and extension effort and deficient co-ordination between the two. This is illustrated by the problem of thrips in eggplant. The lack of focus in the research and extension effort has prompted NWC to request assistance in establishing its own extension service. Extension effort that focused on these readily available local market opportunities could prove very beneficial. An example would be demonstrating to farmers the simple techniques of off-season pineapple production.

Adjustments in Quarantine arrangements: For a number of products, internal quarantine arrangements are identified as why full advantage is not taken of existing marketing opportunities. Most could be solved with minor adjustments to the respective pathways. There is also perception of inconsistency and bias on the part of the Quarantine Service that has undermined industry morale and has adversely affected export performance. To reduce the perception of bias and inconsistency it is recommended that Quarantine Officers be regularly rotated in their duty assignments.

Issues to Realise Type 2 Market Opportunities

The existing HTFA facility has the capacity to handle over 2,000 tonnes of product per annum. It is wasteful of resources that after 7 years of operation only four products are handled by the facility, when identified markets are readily available for other products. A similar situation exists for identified non-host products such as pumpkins.

Accelerating export protocol development: The pace of protocol development needs again to step up if the substantial export potential is to be realised. It is recommended that a Steering Committee be formed for the specific purpose of protocol development. The Committee should comprise of the Manager of NWC, the most senior Quarantine Officer responsible for quarantine protocol development, Research Division's senior entomologist and plant pathologist, and the Head of the Fruit Fly team.

Certified organic agriculture capacity: To meet available certified organic market opportunities requires effort in applied and collaborative research; focused extension to transfer organic production methods to farmers; and, in the development of an internationally recognised local certifying capability to substantially reduce the overhead cost of obtaining organic certification for small agribusinesses.

Non-quarantine market access Issues: The development of kura exports are constrained by the EU's Novel Food Regulation (NFR). Such market access issues have to be dealt with

by government at the highest level. The best results might be achieved through regional representation via the Forum Secretariat. The NFR also applies to other unique traditional products from the Pacific islands such as forest nuts.

Applied research to develop breadfruit: The realisation of the considerable commercial potential of breadfruit will require a substantial applied research effort. This needs to be multidisciplinary in nature, involving agronomy and horticulture, entomology, harvest and postharvest handling, agricultural engineering, agroprocessing and farm economics. Perhaps the most urgent research needs lies in the field of postharvest handling.
Linking smallholders to the tourism sector: To expand sales to the hotel market, local producers have to be able to ensure quality and more particularly reliability and timeliness of supply. Meeting these requirements can often be very difficult for smallholder producers. MASLR, with assistance from FAO, have attempted to address this problem with a pilot Market Centre Project at Lokia on the East Bank of the Sigatoka River. Success will depend on being able to run these Marketing Centres as businesses, in which the pricing structure reflects the true cost of providing marketing services. Considerable attention needs to be given to business and marketing training.

Requirements for commercial dhal and feed grain production: The manufacturing and marketing infrastructure is already in place for the establishment of a significant commercial pulse industry. Existing companies have expressed a keen interest in sourcing their raw materials locally. What is required is local supply available at competitive prices.

The Legalega Research Station has over the years put considerable effort into developing improved pulse varieties. Particularly promising are some of the new improved pigeon pea varieties that offer higher yields and year round production. A concerted and focused extension effort is now required to get these varieties adopted by farmers. This extension effort needs to be in collaboration with the companies who will be the buyers of these pulses.

Previous efforts to promote commercial feed grains, such as maize and sorghum, have not been successful. Generally there has been an inability to profitably produce maize of the required quality. Some of the reasons identified for this are:

prices have been unattractive relative to the cane monoculture;
lack of appropriate technology to improve labour productivity;
inadequate drying and storage facilities;
farmers not honouring contracts and selling to middlemen who offer a higher price, without supplying any inputs.

Requirements for the Realisation of Type 3 Market Opportunities

The realisation of all the examples of Type 3 market opportunity given depend on substantial agribusiness investment. Government has a role to play in encouraging such investments in providing infrastructure and other appropriate incentives, including giving confidence to investors.

For example substantial investment in export agriculture in Vanua Levu is unlikely to occur unless there is an international port that allows direct shipments to overseas markets. Any would be investor will require adequate road infrastructure, power, telecommunications and water supply. To overcome the locational disadvantages of operating on Vanua Levu the investor may also require additional tax and other incentives.

## 6.0 MARKET OPPORTUNITIES THROUGH JMO AGRI EXPORTS FIJI LTD WEEKLY REQUIREMENTS OF THIS EXPORT MARKET TO AUSTRALIA

| COMMODITY | 1ST YEAR | 2ST YEAR | 3ST YEAR | 4ST YEAR | 5ST YEAR |
|---|---|---|---|---|---|
| Dalo - tausala | 10 | 15 | 20 | 25 | 30 |
| | | | | | |
| Dalo – white variety | 5 | 10 | 15 | 20 | 20 |
| | | | | | |
| Dalo – ni-Tana -PM | 10 | 10 | 15 | 15 | 20 |
| Via PM | 20 | 20 | 20 | 30 | 30 |
| | | | | | |
| Yam-purple – PS | 50 | 50 | 60 | 65 | 65 |
| | | | | | |
| Yam-white-PS | 60 | 60 | 60 | 70 | 70 |
| | | | | | |
| Cassava-yellow PM | 30 | 30 | 35 | 35 | 40 |
| | | | | | |
| Cassava – white PM | 40 | 45 | 50 | 60 | 80 |
| | | | | | |
| Cassava-leaves PM | 5 | 8 | 10 | 10 | 15 |
| | | | | | |
| Breadfruit PS | 10 | 10 | 15 | 20 | 20 |
| | | | | | |
| Jackfruit PS | 10 | 10 | 10 | 15 | 20 |
| | | | | | |
| Duruka PS | 10 | 10 | 15 | 20 | 30 |
| | | | | | |
| Seekho PM | 5 | 8 | 10 | 10 | 15 |
| | | | | | |
| Ivi PS | 10 | 15 | 20 | 20 | 25 |
| | | | | | |
| Coconut –dry PW | 100 doz | 150 doz | 200 doz | 200 doz | 250 doz |
| | | | | | |
| Coconut – green PW | 20 doz | 30 doz | 40 doz | 50doz | 60doz |
| | | | | | |
| Cocoa beans PS | 30 | 50 | 60 | 80 | 100 |
| | | | | | |
| Tumric roots PS | 50 | 50 | 100 | 100 | 100 |
| **COMMODITY** | **1ST YEAR** | **2ST YEAR** | **3ST YEAR** | **4ST YEAR** | **5ST YEAR** |
| Talapia PM | 20 | 30 | 40 | 50 | 50 |
| | | | | | |
| Milk Fish PM | 10 | 15 | 20 | 25 | 30 |
| | | | | | |
| Reef Fish PM | 20 | 25 | 30 | 35 | 40 |
| | | | | | |
| Assorted Reef Fish | 5 | 5 | 6 | 7 | 8 |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Sliced Tuna | 5 | 5 | 6 | 7 | 8 |
| | | | | | |
| Eels | | 2 | 2 | 3 | 4 |
| | | | | | |
| Kai-Freshwater PM | 2 | 2 | 3 | 5 | 5 |
| | | | | | |
| Lobster | 1 | 2 | 2 | 3 | 3 |
| | | | | | |
| Prawn | 1 | 2 | 3 | 3 | 3 |
| | | | | | |
| Bongo chillies PM | .05 | .05 | .05 | .05 | .05 |
| | | | | | |
| Long Chillies | .05 | .05 | .05 | .05 | .05 |
| | | | | | |
| Bird eye Chillies | .05 | .05 | .05 | .05 | .05 |
| | | | | | |
| Boda Beans PM | 1 | 1 | 1 | 1 | 1 |
| | | | | | |
| Aamdaa (Pickle) PS | 1 | 1 | 1 | 1 | 1 |
| | | | | | |
| Mango (Pickle) PS | 5 | 5 | 5 | 5 | 5 |
| | | | | | |
| Kamarak (Pickle) PS | 5 | 5 | 5 | 5 | 5 |
| | | | | | |
| Tamarind Chutney | 5 | 5 | 5 | 5 | 5 |
| | | | | | |
| Khatai (dry mango) | 5 | 5 | 5 | 5 | 5 |

6.2 Fiji farm gate price in domestic currency - Fijian Dollars.

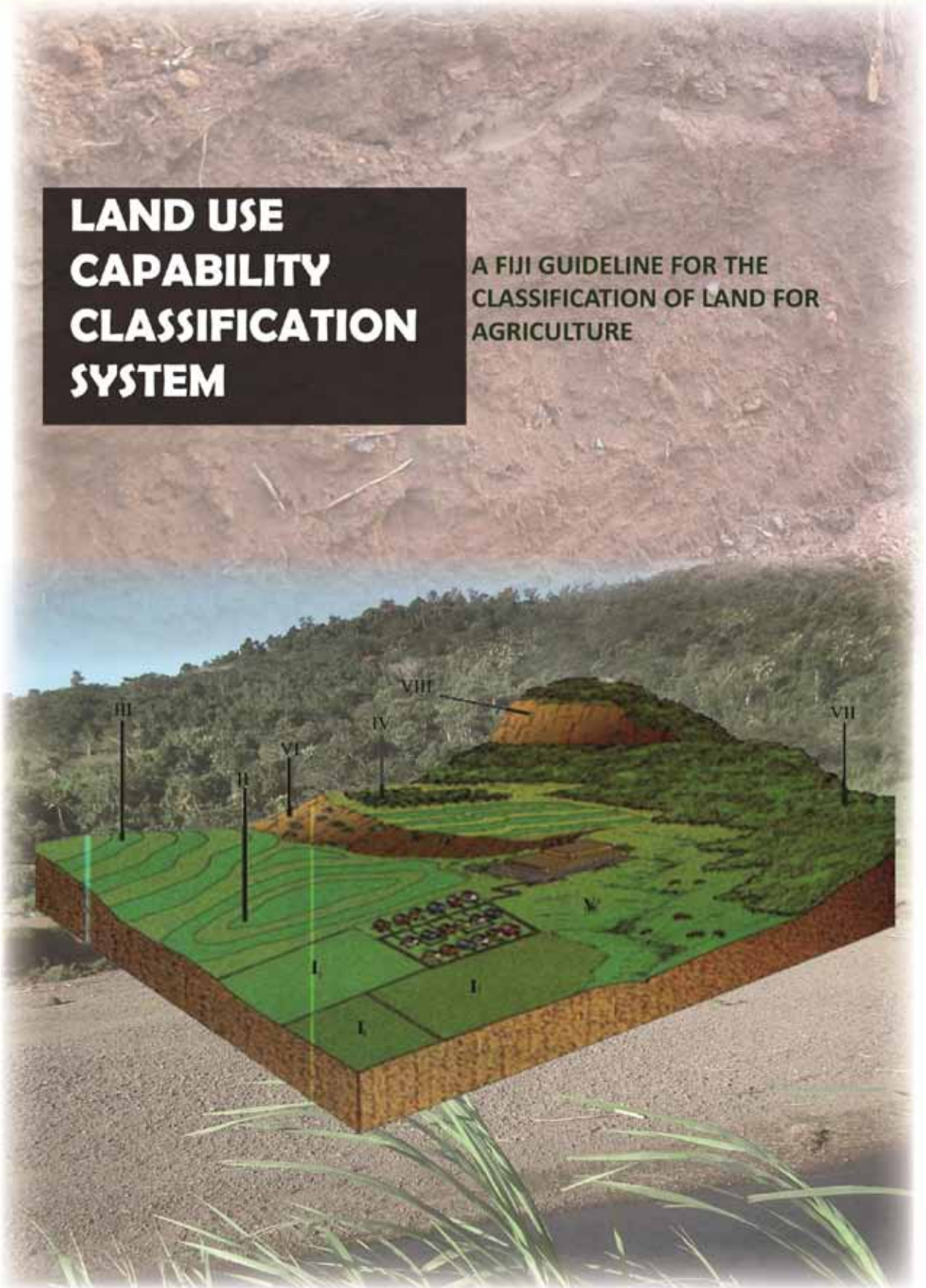
* Imminent Price reviewable after every financial year.

| Commodity | Farm gate price @ kg | Important variants | Other comments |
|---|---|---|---|
| Dalo -Tausala | **1.60** | Except all sizes, but must meet grading and export quality. | Other grade directed to local market |
| Dalo - white | **1.00** | " | " |
| Dalo – Tana | **.80c** | " | " |
| Via | **1.80** | " | " |
| Yam - purple | **1.00** | " | " |
| Yam – white | **1.00** | " | " |
| Cassava – white | **.60c** | " | " |
| Cassava - yellow | **.60c** | " | " |

| | | | |
|---|---|---|---|
| Cassava – leaves | **2.00** | " | Tender leaves only |
| Breadfruit | **1.60** | wastage allowance | " |
| Jackfruit | **1.80** | wastage allowance | " |
| Duruka | **6.00** | wastage allowance | |
| Seekho | **2.00** | | |
| Ivi | **5.50** | Quality screen | |
| Cocoa beans G 1 | **8.00** | Graded | |
| Cocoa beans G 1 | **6.00** | Graded | |
| Dry Coconut | ***3.00@doz** | Good size | |
| Tumric roots | **5.00** | | |
| Dried Tamatind | **5.00** | Seedless | |
| | **FISH/MARINE** | | |
| Nakai | **3.50** | With shell | Fresh |
| Nakai | **12.00** | Without shell | |
| Talapia | **4.50** | Exportable size | |
| Milk Fish | **4.50** | " | |
| Reef Fish | **12.00** | " | |
| Taa Fish | **10.00** | " | |

APPENDIX 11

# LAND USE CAPABILITY CLASSIFICATION SYSTEM



# LAND USE CAPABILITY CLASSIFICATION SYTEM

*A Fiji Guideline for the classification of land for agriculture*

*Compiled and Produced by:*

*Land Use Planning Section*
*Land Resource Planning & Development*
*Department of Agriculture*

## INTRODUCTION

Arising out of preliminary trials of classification in Fiji and from a study of land use capability classification, surveying and mapping in New Zealand, as well as advise from visiting scientists, the Ministry of Agriculture and Fisheries finally decided to adopt, with modifications to suit local conditions, the New Zealand Land Use Capability System as described in the "Land Use Capability Survey Handbook" – 1974 edition.

The N. Z. classification system is itself a modified version of the American system on which many other international classification systems in the use to-day are based.

In modifying the New Zealand system to suit Fiji conditions, changes were made to areas affected by differences in climatic conditions, in the types of crops grown and their land requirements, in the kind and level of management systems applied, and in cultivation methods used.

This new classification replaces the 7 class system introduced by the Land Use Section in 1972. In its present form the classification is considered to be soundly based and adequate, and should therefore more than satisfactorily meet the country's present and future needs in the fields of land development planning, land valuation, soil conservation, as well as in the promotion of recommended land use practices for safe-guarding expanding and sustained production from the land.

During the course of the national land inventory programme, it is expected that further changes to the system will become necessary as and when more accurate and up to date information become available.

## 1. LAND INVENTORY MAPPING SYSTEM

The N. Z. land inventory mapping system as described in the Land Use Capability Survey Handbook, is being adopted here with slight modifications. The land resource inventory provides an objective field measurement and record of those field characteristics of the land that existed at a particular site. As a basis for land use capability assessment an inventory is made of the facts about the landThe following basic information is required in order to compile a "Land Inventory Map":-

1. Geology
2. Soils
3. Relief
4. Erosion
5. Vegetation
6. Land Use
7. Climate

### 1.1 Geology

This is important and needs recording only where the rock type is a major contributing factor to the erosion pattern in an area or region. However, little is known about this erosion/rocktype relationship, and this aspect therefore needs to be studied further to identify the more important rock types, before deciding on a more appropriate grouping and allocation of symbols.

Until such time as a meaningful and workable system could be devised geology may be omitted from the land inventory formula.

### 1.2 Soils

The initial classification of the soils of Fiji was fully described by I.T. Twyford and A.C.S Wright 2 miles to 1 inch reconnaissarre soil map published in 1964; but they require adaptation in the field to the scale of the land inventory map (1:50,000 or 63 chains to 1 inch). The main soils are described in the Soil Taxonomic Unit Description sheets where 227 soil series were identified and mapped fro Fiji. These are available from the Land Use section of the Department of Agriculture. There are also other more detailed soil maps of certain areas, and where applicable these should be used (e.g. Navua flats by Hunting Technical Service Ltd – 1969; Rewa Basin by FAO – 1972; Sigatoka Valley by S. Chandra – 1971, etc.).

The basic soil unit is the Soil type or the Soil Phase, and this should be the unit for the inventory formula. The unit symbol adopted in the soil survey concerned will be followed e.g. 27f = Sote clay: 27fH = Sote clay hilly phase, and so on. Also the soil survey from which the soil name (symbol) is obtained should be quoted in the land inventory map legend.

In areas where no soil exists e.g. bare rock surfaces or extremely bouldery areas, if mappable, the symbol B. R. (for Bare Rock) is used in the place of the soil unit, similarly, if not mappable but significant, B. R. or R. O. (for rock outcrop) is placed either before or after the soil type symbol depending on which of the two is more dominant.

### 1.3 Relief

This is expressed as slope in degrees and is measured with an abney level or a slope meter. Slope will be recorded in accordance with the slope grouping given under the "Limitation standards for LUC classes".

The "C" slope group is subdivided into C- and C+ so as to suit the LUC classification. However, the minus and plus signs may also be used in other groups for the purpose of indicating which end of the group the slope is. A slope which is on the borderline between two groups can be shown as B/C or D/E, etc., placing the more dominant group first. Similarly compound slopes can be expressed as B + F or D + E etc., where B or D slopes are more dominant than F or E slopes. Double symbols should be used only where the less dominant slope group is almost equal in significance to the dominant group.

### 1.4 Erosion

Only accelerated erosion or erosion which has been initiated or intensified by the action of man, either by his management of the land, or the effect of the animals he has introduced is to be recorded in the land inventory formula, and this will be done in accordance with the "Present Erosion" classification given under Limitation standards for LUC Classes.

Degree of erosion can be represented by (a) percentage of bare ground exposed to erosion, or (b), severity or seriousness of types such as gully and a stream bank erosion, or mass movements.

Bare ground, in this case is that portion devoid of vegetation as a direct result of erosion; it does not however apply to areas made through clearing and/or burning for the purpose of cultivation, or ploughed land, or to fallow land. This is land that became bare largely as a result of sheet or wind erosion, and is recorded as a percentage of an inventory unit on a 1-5 scale of intensity.

Severity or seriousness applied to such erosion types as slip, slump, flow, gully, tunnel gully, rill, streambank, and deposition. The severity is measured on the basis of standard selected sites influenced by parent material, personal judgement, physical loss of land and cost of repair.

Additional data may be shown according to local requirements of the surveyor, e.g. it may be necessary to record the percentage of soil loss, especially in sheet and wind eroded areas.

### 1.5 Vegetation

This is recorded under five main groups – cropland, grassland or pasture, weedland, scrubland, and forest land. For vegetation grouping and selected symbols see under limitation standards for LUC Classes.

Capital letters are used where the type of vegetation comprises more than 40% of the cover; small letters where it is less than 40% (e.g. P or p.). Any combination of the above symbols may be used in descending order of dominance (e.g. C1 + C2b + o2c = about 50% of cane, 45% rainfed rice and 5% dryland rice).

Small letters are used to indicate species or association e.g. P1a = "P" for pasture or grassland, "1" for established pasture and "a" for paragrass.
In the case of a complex vegetation pattern, its recording should be limited to the 3 more dominant types or association only.

### 1.6 Land Use

This is recorded in terms of crops grown, in the same manner as vegetation types are recorded. Depending on local requirements, additional notes may be made on the history of land use, past and present management systems, water supply, fencing, stock carrying capacity, access, etc.

## 1.7 Climate

The two important factors, rainfall and temperature, should be accurately recorded in accordance with the classification given under limitation standards for LUC classes. Additional notes may be made on humidity, sunshine, rainfall intensity, etc. in as far as they affect land use and flooding.

The rainfall map by L. S. Matthews of the Fiji Meteorological Services should be used as a general guide in determining the rainfall groups of an area. This is a 5 region rainfall grouping based on the average annual rainfall over the past 20 years. Current trends and other detailed information can be obtained from local Met. Stations.

## 1.8 Land Inventory Formula

The formula which follows shows in a single form how distinct land inventory units are delineated on the land inventory map. Each inventory unit has a group of symbols which gives information about the geology and/or soil, the landslope, existing erosion, and the present vegetation cover or crops.

The standard formula layout is as follows:-

GEOLOGY - SOIL - SLOPE

---

EXISTING EROSION - VEGETATION/LAND USE

Example: BA - 20a - D + E

---

25h, 1G - P1b, S2, W2.

### *1.8.1 Interpretation*

The dominant rock type is calcareous basaltic agglomerate; the soil type is Tavua bouldery clay of the Nigrescent group; topography is rolling to steep with slopes 16 - 25° dominant; the area is affected by sheet and gully erosion classified as moderate and slight; the vegetation is a combination of blue grass & reeds with lantana found in some places.

An alternative form of layout which is recommended for narrow or irregular shape inventory units is:-

BA - 20a - D + E - 25h, 1G - P1b, S2, W2.

In addition to the information presented in formula form, other information associated with the soil type e.g. drainage, depth or shallowness, stoniness, natural fertility, salinity, moisture holding capacity or liability to drought, structural stability or susceptibility to erosion, together with information necessary for assessment of the use capability of the land e.g. altitude, liability to flooding, and climate, should also be accurately recorded in the "Land Inventory Record Book", in accordance with their respective grouping provided under the "Limitation standards for land use capability classes", prepared by the Land Use Section.

## 2. GUIDELINES FOR LAND INVENTORY SYSTEMS AND MAPPING

### 2.1 Slope

| Group Symbol | Slope Range (degrees) | Description |
|---|---|---|
| A | 0-3 | Flat to gently undulating |
| B | 4-7 | Undulating |
| C⁻ | 8-11 | Gently rolling |
| C+ | 12-15 | Rolling |
| D | 16-20 | Moderately steep |
| E | 21-25 | Steep |
| F | 26-35 | Very steep |
| G | >35 | Extremely steep |

Slope is undoubtedly the most important factor to be considered in a capability classification. The intensity and convenience of tillage depends largely on the degree of the slope

### 2.2 Present erosion

| Symbol | Description |
|---|---|
| 0 | No erosion – no evidence |
| 1 | Slight erosion – some evidence |
| 2 | Moderate erosion – more evidence |
| 3 | Severe erosion – getting serious |
| 4 | Very severe erosion – very serious |
| 5 | Extremely severe erosion |

Erosion removes fertile topsoil and also reduces soil depth. Many large gullies on the land may interfere with normal cultivation

### 2.3 Susceptibility to erosion

| Symbol | Description |
|---|---|
| 0 | Not susceptible - stable |
| 1 | Slightly susceptible |
| 2 | Moderately susceptible |
| 3 | Severely susceptible - unstable |
| 4 | Very severe susceptibility –very unstable |
| 5 | Extremely susceptible - unstable |

## 2.4 Erosion types

| Symbol | Description | |
|---|---|---|
| Sh | Sheet erosion | Recorded on areal basis |
| W | Wind erosion | |
| Sc | Scree creep | |
| Sl | Slip erosion | Recorded on the basis of seriousness |
| Su | Slump erosion | |
| F | Flow erosion | |
| R | Rill erosion | |
| T | Tunnel Gully | |
| Sb | Streambank erosion | |
| G | Gully erosion | |
| D | Deposition by water | |
| Dw | Deposition by wind | |

## 2.5 Drainage (wetness)

| Symbol | Description | Example |
|---|---|---|
| A | Well drained | Rewa series |
| B | Slight wetness | Rewa mottled series |
| C | Moderate wetness | Navua series |
| D | Severe wetness | Tokotoko series |
| E | Very severe wetness | Nausori series |

## 2.6 Damaging flooding (wetness)

| Symbol | Description |
|---|---|
| A | Very occasional – once in 8 years |
| B | Occasional – once in 5 - 8 years |
| C | Regular – once in 3- 4 years |
| D | Frequent – once in 2 years |
| E | Very frequent – once or more annually |

## 2.7 Depth (shallowness)

| Symbol | Description |
|---|---|
| A | Deep (>90cm of A and B horizons) |
| B | Slightly shallow (60-90cm) |
| C | Moderately shallow (30-60cm) |
| D | Shallow (15-30cm) |
| E | Very shallow (<15cm of A and B horizons) |

Soil depth is probably one of the most important factors in classifying land capability. The texture of the soil cannot be easily modified. However, certain crops can be grown on very light soil or heavy soil.

### 2.8 Fertility

| Symbol | Description | Example |
|---|---|---|
| A | Fertility | Most alluvial soils |
| B | Slightly infertile | Some Latosolic, Nigrescent and Colluvial soils |
| C | Moderately infertile | Latosolic, Nigrescent, some Humic Latosol and Gley soils |
| D | Infertile | Humic Latosol, Gley soil, Coastal sand and some Podsolic soils |
| E | Very infertile | Podsolic soils and some Ferrugineous Latosol |
| F | Extremely infertile | Ferrugineous Latosol soils |

### 2.9 Stoniness

| Symbol | Description |
|---|---|
| A | No stones or very slightly stony |
| B | Slightly stony - mainly gravels - suitable for use of machinery |
| C | Moderately stony - gravels and stones – suitable for use of machinery after the stones are collected |
| D | Stony – stones and boulders – unsuitable for use of machinery |
| E | Very stony – unsuitable for cropping but suitable for pasture |
| F | Very boulder – only marginal for pasture or for productive vegetation |
| G | Extremely boulder or rocky – unsuitable for productive vegetation |
| ***Definition of stones:*** <br> ***Gravel = <2.5cm diameter*** <br> ***Stone = 2.5-20cm diameter*** <br> ***Boulder = >20cm diameter*** | |

Stoniness, wetness, internal drainage, the height of the water table and overflow. Soil moisture holding capacity and salinity are not important because moisture is frequently replenished and the presence of toxic salts may not be common under the kind of climate and topography

### 2.10 Moisture holding capacity

| Symbol | Description |
|---|---|
| A | Very high – deep to moderately shallow, heavy texture (heavy clay) |
| B | High – deep to moderately shallow, slightly heavy texture (clayey soils) |
| C | Medium – deep to moderately shallow, medium texture; or shallow, heavy texture |
| D | Low - deep to moderately shallow, light texture; or shallow, slightly heavy to medium texture |
| E | Very low – shallow, light texture; or very shallow, heavy to medium texture |
| F | Extremely low – very shallow, light texture |

| *Definition of texture:* | | |
|---|---|---|
| *Heavy texture* | = | *Heavy clay soils* |
| *Slightly heavy texture* | = | *Clayey soils not lighter than sandy clay loam* |
| *Medium texture* | = | *Loam and loamy soils* |
| *Light texture* | = | *Sand* |

### 2.11 Salinity

| Symbol | Description | Example |
|---|---|---|
| A | Non saline to very slightly saline | Rewa soils |
| B | Slightly salinity | Nakelo soils |
| C | Moderate to severe salinity | Soso soils |
| E | Extremely saline | Dogo soils |

### 2.12 Mangrove swamp

| Symbol | Description |
|---|---|
| A | Not difficult to reclaim for cropping |
| B | Difficult but can be reclaimed for cropping |
| C | Too difficult to reclaim for cropping but possible to develop for marginal pasture |
| D | Not feasible to develop for productive vegetation |

### 2.13 Peat swamp

| Symbol | Description |
|---|---|
| A | Not difficult to develop for cropping |
| B | Difficult but can be developed for cropping |
| C | Too difficult to develop for cropping but can be developed marginal for pasture |
| D | Not feasible to develop for productive vegetation |

### 2.14 Rainfall (climate)

| Symbol | Description |
|---|---|
| A | Very high (>4000mm) |
| B | High (3000 – 4000mm) |
| C | Moderate (2000 – 3000mm) |
| D | Low (1500 – 2000mm) |
| E | Very Low (<1500mm) |

Climatic limitations, such as drought and low temperature for cropping, heavy rainfall, excessive runoff and floods may be common.

### 2.15 Temperature (climate)

| Symbol | Description |
|---|---|
| A | Low – Winter temperature sometimes falling below 20°C; 70°F |
| B | High – Winter temperature never fell below 20°C; 70°F |

### 2.16 Altitude (climate)

| Symbol | Description |
|---|---|
| A | Low (<300m above sea level) |
| B | Medium (300 – 600m) |
| C | High (600 – 1000m) |
| D | Very high (>1000m) |

### 2.17 Vegetation/Land Use

| Symbol | Description | Symbol | Description | Symbol | Description |
|---|---|---|---|---|---|
| C | Cropland | P1 | Established pasture | S | Scrub land |
| C1 | Sugar cane | P1a | Para grass | S1 | Braeken fern |
| C2 | Rice | P1b | Blue grass | S2 | Reeds |
| C2a | Irrigated rice | P1c | Grass-Legume combination | S3 | Guava |
| C2b | Rainfed rice | P1d | Other species | S4 | Vaivai |
| C2c | Dryland rice | P2 | Mission grass | S5 | Mangrove |
| C3 | Cereals (maize, sorghum, broomcorn) | P3 | Native grass land | S6 | Mixed native scrub association |
| C4 | Market vegetables (commercial gardens) | P4 | Unspecified grass association | F | Forest land |
| C5 | Coconuts | W | Weeds | F1 | Native forest |
| C6 | Bananas | W1 | Navua sedge | F1a | Hard wood |
| C7 | Cocoa | W2 | Lantana | F1b | Soft wood |
| C8 | Citrus | W3 | Solanum | F1c | Other species |
| C9 | Pineapples | W4 | Noogoorabur | F2 | Exotic forest |
| C10 | Ginger | W5 | Mint weed | F2a | Pine |
| C11 | Subsistence cultivation | W6 | Hibiscus burr | F2b | Mahogany |
| C12 | All others | W7 | Swamp vegetation (not including mangrove) | F2c | Other species |
| P | Pasture-Grassland | W8 | All others | F3 | Unspecified forest association |

## 3. THE CLASSIFICATION SYSTEM

Land use capability classification is a systematic arrangement of different kinds of land according to those properties that determine its capacity for permanent sustained production. The word "capability" is used in the sense of "suitability for productive use" after taking into account the physical limitations the land may have.

This capacity depends largely on the physical qualities of the soil and the environment; these are frequently far from ideal, and the difference between the ideal and the actual is regarded as limitations imposed by these soil qualities and by the environment.

These limitations affect the productivity of the land, the number and complexity of corrective practices needed and the type and intensity of land use. The degree of limitations can be assessed from:

a) susceptibility to erosion,
(b) steepness of slope,
(c) liability to flooding, wetness, or to drought,
(d) salinity,
(e) depth of soil,
(f) soil texture, structure, and fertility,
(g) stoniness, and
(h) climate.

As a basis for this assessment an inventory is made on the facts about the land, and the information is recorded on the "Land Inventory Map" on which distinct "inventory units" are shown. The information on this map is combined with other information on geology, climate, land use, results of research, and farming experiences to assess the capacity of the land for permanent sustained production.

## 4. CATEGORIES OF THE CLASSIFICATION

The classification provides for three categories of grouping of the land inventory units all of which are decided objectively, but which are based on the physical qualities of a soil and its particular site. The three categories are; (a) major class, (b) subclass, and (c) capability unit.

### 4.1 Description of the major class

The first grouping is into eight major classes. Class 1 – 1V comprise land suitable for arable cultivation; land in classes V – VII is not suitable for arable cultivation but suitable for pastoral or forestry use; and class VIII is land suitable only for protective purposes.

The four arable and four non-arable classes are arranged in the order of increasing degree of limitation or hazard to use, from class 1 to class VIII. Correspondingly the range of uses to which the land may be put decreases from class 1 to class VII, with class VIII having land least suitable for productive use.

The major class gives information about the general limitations of the land only (i.e. total degree of limitation); it shows only the location, amount and general suitability of the land for agricultural, pastoral or forestry use.

Each major class may include many different kinds of land units or soils, and many of the units within a class may require different management treatments. Thus it is difficult to make valid generalisations at the major class level about suitable kinds of crops or other management needs.

### 4.2 Description of the subclass

The second category, the subclass, provides for a grouping of units within the major class that have the same kind of limitation or hazard. The four general kinds of limitation recognised are:

**E** - **Erodibility**

**W** - **Wetness**

**S** - **Soil limitation within the rooting zone.**

**C** - **Climate**

These are the subclasses and they may be used in two ways – either as broad divisions of the major classes at a more general level of classification for land use, or as groupings of the units for detailed classifications.

***Subclass E*:** Erodibility, where erosion susceptibility, past erosion damage, or steepness of slope are the main limitations to use. This subclass is present in all major classes except class 1 which is of flat land with soils of good structural stability.

***Subclass W*:** Wetness, where the main limitations to use are due to soils of poor drainage or a high water table, or to damaging flooding from rivers or coastal waters, or to areas of deep peat, or larger mangrove swamps.

The subclass apply in all major classes except class V. Wetness due to poor drainage or high water table apply only in classes 1-IV; on damaging flooding the wetness limitations occur in classes 1-IV and in VI; and on peat and mangrove, the limitations are found only in classes VI and VIII.

***Subclass S:*** Soil limitations within the rooting zone of plants. These are limitations on shallowness, stoniness, low fertility which is difficult to correct, salinity, toxicity, low moisture holding capacity, unfavourable soil texture and structure, and peaty soils or shallow peat. This subclass is the only one that occurs in all the major classes.

***Subclass C:*** Climatic limitations, where the climate (rainfall, temperature, wind, humidity and sunshine) is the major hazard in the use of the land. The subclass is used only where a less than ideal climate is the only limitation to the use of the land, or where a climatic factor (e.g. too much or too little rain, or extreme temperature) is the dominant limitation to land use. This subclass is present only in major classes 1-VI. It does not occur in VII and VIII.

## 4.3 Explanatory notes

Certain conventions are observed in determining the correct subclass. The dominant kind of limitation determines which of the four subclasses to be used. In practices there are frequently several limitations affecting the one land unit at the same time, and it may be very difficult to decide which should be the dominant subclass, especially where soil (S) limitations and either erosion risk (E) or wetness (W) are very closely related. Where two kinds of limitations are essentially equal, the subclasses are given the following priority – E, W, S, C: that is E is given precedence over W, S & C, and W is given precedence over S & C, and so on. Only in rare cases is more than one subclass used, and in such a case the priority order also applies – e.g. IV E. W.
However, the use of multiple symbols in general negates the objects of classification, one of which is simplicity, and this should be avoided as much as possible.

## 4.4 Description of the capability unit

At the most detailed or lowest level of classification, the capability unit is used as a grouping of those inventory units which respond similarly to the same management, are adapted to the same kinds of crops, pasture or forest species, have about the same potential yield, and require the application of the same conservation measures.

Thus the capability unit comprises land within a subclass, with similar soil characteristic, slope, erodibility, potential productivity, and management requirements. The capability unit groups together similar inventory units and helps to simplify what may be a very complex inventory pattern. When shown together with the major class and subclass, the capability unit provides the additional information about management practices necessary for best use of the land.

The symbol used for the capability unit is a small Arabic numeral placed after the subclass symbol (e.g. III E. 1; III E. 2, etc).At this stage, it is not possible to say how many capability units there will be in each subclass of the eight major classes. This is because it is not practicable now to standardise definitions of units on national level. However, the ultimate objective is to work towards standardisation of the capability unit, first on catchment basis, then on a national basis. Both correlation and standardisation are best tackled when enough is known about this towards the end of the national survey.

## 5. THE CLASSIFICATION

### 5.1 Capability division

The eight major classes can be divided into four "Use capability divisions" as follows:-

| | | Capability Division | Major Class | Slope |
|---|---|---|---|---|
| 1. ARABLE | (a) | Suitable for ploughing and for intensive cropping | 1 – III | 0 - $11^0$ |
| | (b) | Unsuitable for ploughing but suitable for less intensive cropping under traditional cultivation methods. | IV | 12 - $15^0$ |
| 2. NONARABLE | (a) | Unsuitable for arable cropping but suitable for pastoral or forestry use. | V – VII | 16 - $35^0$ |
| | (b) | Unsuitable for productive vegetation; suitable only for protective purposes. | VIII | $35^0$ + |

### 5.2 Description of individual classes

#### *5.2.1 Major Class 1 (map colour – dark green)*

This is very good multiple use land. It is flat (0 - 3°), has deep, easily worked, fertile soils; no risk of erosion, well drained but not seriously affected by drought, and the climate is favourable for the growth of a wide range of crops, and for pasture and forestry.

Class 1 land is confined almost entirely to well drained, recent alluvial areas above frequent flood level.

Subclasses which may occur in major class 1 are:-

1. W.
   1. Very slight initial wetness (soil condition or high water table).
   2. Very slight risk of damaging overflows from rivers and streams (very occasional flooding).

1. S.
   1. Very slight stoniness (presence of river gravels)
   2. Very slight salinity (easily removable by permanent work).

1. C.
   1. Where everything else is alright except climate (areas in rainfall zone B & C altitude class A, and temperate Class A).

   Subclass C should be the best of all subclasses in major class 1.

*Arable cropping on Class I land*

### *5.2.2 Major Class II (map colour – light green)*

This is good arable land with slight limitations which make it more difficult to manage than class 1. Management and conservation practices to overcome those limitations are easy to apply.

The land may be flat to gently undulating (0 - 7°), well drained to moderately drained, deep to slightly shallow, and fertile to moderately fertile.

Class II land is confined mainly to alluvial areas which are either slightly poorly drained or subject to regular flooding, and to flattish areas of better nigrescent and latosolic soils. The land can be used for arable cultivation, pasture or forestry.

Subclasses which may occur in major class II are:-

| | | |
|---|---|---|
| II.E. | 1. | "B" slopes (4-7°) |
| | 2. | Slight susceptibility to erosion. |
| II.W. | 1. | Slight to moderate wetness after drainage. |
| | 2. | Slight to moderate risk of damaging flooding. |
| II.S. | 1. | Slight stoniness (fine gravels). |
| | 2. | Slight infertility easy to correct. |
| | 3. | Unfavourable texture and structure – difficult in working. |
| | 4. | Slight salinity. |
| | 5. | Slight shallowness (soils of moderate depth). |
| II.C. | 1. | Class 1 land in "A" rainfall zone (>4000 mm) Too much rain; and in "E" rainfall zone (<1500mm). |
| | 2. | Class 1 land on medium and high altitude areas (600-1000m) above sea level) – Cloudiness, less sunshine. |
| | 3. | Class 1 land in areas of low winter temperature |

*Vegetable farming on Class IIs land, Nadi*

*Pineapple farms on Class IIe land in Ba*

***Intensive arable cropping on Class II lands***

### *5.2.3 Major Class III (map colour – light blue)*

This is fair arable land with moderate limitations which restrict the choice of plants grown, or make special conservation practices necessary, or limit land use in both of these ways. The land may be flat or gently sloping (0 - 11°), slightly unstable, of moderate severe wetness, subject to frequent damaging flooding, of shallow, moderately stony, and/or infertile soils.

Class III land occurs mainly in areas of gley soils, lower river terraces, sandy coastal flats, nigrescent areas of moderate slopes, and in areas of better Humic Latosol and podsolic soils.
The land may be used for arable cultivation, pasture or forestry. Subclasses which may occur in major class III are:-

III.E.

1. Moderate slopes – "C" (8 - 11°).
2. Moderate susceptibility to erosion.
3. Severe effects of past erosion.

III.W.

1. Moderate to severe wetness.
2. Frequent damaging flooding.

III. S.

1. Moderately stony (gravels and stones – can be collected to enable ploughing
2. Low fertility not easy to correct.
3. Low moisture holding capacity.
4. Moderate salinity.
5. Shallow soils (depth class "C").
6. Areas of shallow peat-easy to develop for cropping.

III.C.

1. Classes 1 & II land in "A & D" rainfall zone (1500 – 2000 mm) – Too little rain.
2. Classes 1 & II land in high altitude areas (610 – 914m above sea level).
3. Class II land in areas of low winter temperatures.

*Cane farming on Class IIIw land*

*Rice farming on Class IIIw land*

### *5.2.4 Major Class IV (map colour – light brown)*

This is marginal arable land with severe limitations which restrict the choice of crops grown, or necessitate intensive conservation treatment and very careful management, or which may affect land use in both of these ways.

Class IV land may be flat to rolling (0 - 15°) land may comprise one or more of the following – poor to very poorly drained; stony or bouldery or both; very shallow soils; infertile soils; coarse textured soils very low in moisture holding capacity; or mangrove or peat swamps which are not too difficult to reclaim for cropping.

Common soil types of class IV land are: strongly gleyed soils, some Humic latosols, some podsolic soils; or colluvium derived from Ferrugineous latosol.

Because of these limitations, and in the case of rolling land the difficulty of installing and maintaining conservation work, this land class is used mainly for pasture, coconut plantations, or subsistence cultivation under traditional cultivation methods.

The upper slope limit for this land class is $C^{+}$ (12 - 15°); this is too steep for ploughing either by machinery or by draught animals. Accordingly cropping in the E subclass will be restricted to subsistence cultivation using traditional methods including shifting.

Subclasses which may occur in major class IV are:-

IV. E - 1. Rolling slopes – $C^{+}$ (12 - 15°).

2. High susceptibility to erosion. Very unstable under arable cropping.

3. Very severe effects of past erosion.

IV. W - 1. Very severe wetness (very poorly drained areas (mineral soils).

2. High risk of damaging flooding (very frequent flooding).

IV. S - 1. Severe stoniness – cannot be ploughed but suitable for traditional cultivation methods.

2. Infertile soils (e.g. Humic latosol and podsolic soils) – difficult to correct with the use of fertilisers.

3. Coarse textured soils very low in moisture holding capacity, liable to severe drought.

4. High salinity – areas of mangrove swamps not too difficult to reclaim for cropping.

5. Very shallow soils (depth class "D").

6. Areas of moderately shallow peat which can be developed for cropping.

IV. C - 1. Classes 1-II land in the "E" rainfall zone and class III land in A.D and E rainfall zones.

2. Some class III land in C & D altitude groups.

3. Class III land in areas of low winter temperatures.

*Sugar cane on LUC class IV land (IVe )in Nadi*

*Cultivated class IV land (IVe) in, Sakoca, Savutalele*

### *5.2.5 Major Class V (map colour – light yellow)*

This land class is unsuitable for arable cropping but suitable for pastoral or forestry use. Steepness (D slopes – 16 - 20°) or stoniness (Class E) are the main limitations which render it non arable and restricting it to pastoral use or productive forestry.

The erosion risk on D slopes under pastoral or forestry use in only very slight, but on such a slope this hazard would be too great if put under arable cultivation. Where the slope is less than 15°), the land may be too stony or bouldery for the use of machinery in arable cultivation.

Thus Class V, in effect, now becomes the best non arable class, conforming to the progression from 1 to VIII.

Subclasses which may be found in major class V are:-

V. E. 1. Strongly rolling slopes (D-16 to 20°).
2. Slight susceptibility to erosion (Class 3).

V.S. - 1. Stoniness (class E); unsuitable for cropping.

V.C. 1. Some class IV land in A and D rainfall zones.
2. Class IV and in areas of low winter temperature.
3. Class III & IV land in C & D altitude groups.

*Grazing on class Ve land*

### 5.2.6 *Major Class VI (map colour-orange)*

This is marginal pastoral land with moderate to severe limitations. It comprises land that is rather too steep for pastoral use (E slopes – 21 to 25°); or that has evidence of severe effects of past erosion (class 3); or that is highly susceptible to erosion (class 4). Class VI may also comprise one or more of the following land types: lower river terraces subject to very frequent flooding (Class E); peat and mangrove swamps which would be too difficult to develop for cropping (Class C in each case); areas which are very stony to very bouldery (Classes E & F), or shallow to very shallow soils (classes D & E); soils which are very low to extremely low in moisture holding capacity (classes E & F), or low to very low in fertility (D & E), or very saline to extremely saline (D & E).

Production or commercial forestry may be the best form of land use where erosion or low fertility are the dominant limitations. On all other land types in this class, pasture should be suitable but its management will require special attention.

Subclasses which may occur in major class VI are:

VI. E -
1. Steep slopes (E-21 to 25°).
2. Severe effects of past erosion (class 3).
3. Moderate to severe susceptibility to erosion (class 4).

VI. W -
1. Very frequent damaging flooding (class E).
3 Peat land (class C).
4 Mangrove swamp (class C). This can also be a soil limitation.

VI. S -
1. Very shallow soils (class D/E).
2. Very stony to very bouldery (class E/F).
3. Infertile to very infertile soils (class D/E).
2. Very low to extremely low in moisture holding capacity (class E/F).
3. Very saline to extremely saline soils (class D/E). This can also be a wetness limitation.

VI. C - 1. Classes IV and V land in E rainfall zone and class IV land in A & D zones, (very low rainfall).
This may not exist.

2. Class IV land in D altitude group (very high altitude).

*Pine plantations on LUC class VIs land (degraded talasiga land)*

*Marginal grazing on class Vie land*

### *5.2.7 Major Class VII (map colour-pink)*

Land in class VII is generally unsuitable for pastoral use, but its suitability for forestry may be fair to marginal. The class comprises land that is either very steep (slope group F – 26 - 35°); or that is very highly susceptible to erosion (class 4), or showing very severe damages from past or present erosion (class 4); or land that is very shallow (class E), very bouldery (class F), or very low in fertility (class E/F).

In areas where the major (dominant) hazard is erosion or low fertility, commercial forestry may be the best form of land use. Where steepness, shallowness or stoniness are the dominant hazards, protection forestry may be practised, or otherwise the land is best left untouched in its natural state. Subclasses which may occur in this major class are:-

VII. E - 1. Very steep slopes (F group).
2. Severe damages from present erosion (class 4)
3. High susceptibility to erosion (class 4)

VII. S - 1. Extreme shallowness (class E)

2. Very stony and bouldery (class F).
3. Very infertile to extremely infertile (class E/F).

Major class VII has no subclass on either wetness or climatic limitations.

*LUC class VIIs with boulder and shallow*

*LUC class VII on steep slopes*

### *5.2.8 Major Class VIII (map colour-red)*

Land in major class VIII is generally unsuitable for productive use in both agriculture and forestry. This is predominantly very steep mountain land mostly above an altitude of 762 metres.

This also includes low land areas in unfavourable situations such as extreme erosion or susceptibility to erosion (e.g.) areas highly susceptible to slumping or earth flow), or extreme stoniness, shallowness, or infertility; and also extremely steep slopes in high to very high rainfall areas (slope G in A and B rainfall zones).

Also included in major class VIII are peat and mangrove swamps whose development is not likely to be economically feasible.

Class VIII land is therefore best protected and/or reserved for watershed and wild life protection purposes, or left in its natural state untouched.

Subclasses which may occur in this major class are:-

VIII. E - 1. Extreme steepness (G slopes)

2. Extreme damage from erosion, or instability (class 5 in both cases).

VIII. W - 1. Peat swamp not feasible to develop

2. Mangrove swamp not feasible to develop.

VIII. S - 1. Extreme shallowness

2. Extreme stoniness

3. Extreme infertility; (not likely to be common.)

*Bouldery, shallow class VIIIs lands*

*Extremely steep with class VIIIe land*

*Unsuitable for production used in Agriculture and Forestry*

## 6. LIMITATION CLASSIFICATION AND STANDARD FOR LAND USE CAPABILITY CLASSES

Factors, both physical and environmental, which affect or limit the use capability or productivity of the land are classified into groups in a manner that suits the capability classification best. For example, slope is classified (according to its steepness) into 8 groups, one for each capability class, from slope group A for major Class 1 to group G for major class VIII.

These standards are for use as a general guide in assessing the capability class for each land type; but the final classification will depend on various other factors including the number and type of limitations affecting the same land type, the number and complexity of corrective practices needed and whether or not the implementation of such practices is economically feasible, the type and intensity of land use that can be applied, etc.

For ease of recording and mapping, each limitation group (e.g. slope A,B,C etc.) and type (e.g. rill, gully, etc. in erosion) is given a standard symbol. Limitation groups are defined both quantitatively and qualitatively and they should therefore be easy to measure.
In some cases examples are given e.g. soil types in wetness and fertility limitations.

### 6.1 Slope

| Group symbol | Slope Range ◦ | Description | LUC Class |
|---|---|---|---|
| A | 0-3 | Flat to gently undulating | I |
| B | 4-7 | Undulating | II |
| C- | 8-11 | Gently rolling | III |
| C+ | 12-15 | Rolling | IV |
| D | 16-20 | Moderately steep | V |
| E | 21-25 | Steep | VI |
| F | 26-35 | Very steep | VII |
| G | 35+ | Extremely steep | VIII |

Note: Slope is measured with an abney level. Slopes in LUC Class 1 – V should be the upper limit for each of those classes. For Class VI, F slopes on stable but not too shallow or too stony land may be included, and similarly class VII may include G slopes.

### 6.2 Present erosion

| Group symbol | Degree of erosion | Percentage of bare ground | LUC Class |
|---|---|---|---|
| 0 | None | None | I, II, V |
| 1 | Slight | 1-10 | |
| 2 | Moderate | 11-20 | III, V |
| 3 | Severe | 21-40 | IV, VI |
| 4 | Very severe | 41-60 | VII |
| 5 | Extreme | 60+ | VIII |

Note: In LUC Classes 1 and II, erosion can be stopped and damages easily repaired. In classes III and V the severity can be reduced from moderate to slight by permanent works. In classes IV and VI it will be difficult to repair the damages which may remain as a permanent limitation; and in classes VII and VIII, it will not be economical to try and repair the damages so as to bring such land into productive use.

### 6.3 Susceptibility to erosion

| Group symbol | Degree of susceptibility | LUC Class |
|---|---|---|
| 0 | Not susceptible (stable) | 1 |
| 1 | Slight susceptibility | II |
| 2 | Moderate susceptibility | III |
| 3 | Severe susceptibility | IV-V |
| 4 | Very susceptible | VI-VII |
| 5 | Extremely susceptible | VIII |

Note: Susceptibility to erosion is determined from slope, rock type and/or soil type, and rainfall intensity. However, the relationship between these factors and land stability is not fully understood, and this aspect therefore requires further study.

### 6.4 Erosion type

| Symbol | Description | |
|---|---|---|
| Sh | Sheet erosion | Recorded on areal basis |
| W | Wind erosion | |
| Sc | Scree erosion | |
| Sl | Slip erosion | Recorded on the basis of seriousness |
| Su | Slump erosion | |
| F | Flow erosion | |
| R | Rill erosion | |
| G | Gully erosion | |
| T | Tunnel gully erosion | |
| D | Deposition by water | |
| DW | Deposition by wind | |

### 6.5 Drainage (wetness)

| Group symbol | Description | Example | LUC Class |
|---|---|---|---|
| A | Well drained | Rewa series | I |
| B | Slight wetness | Rewa mottled series | II |
| C | Moderate wetness | Navua series | III |
| D | Severe wetness | Tokotoko series | |
| E | Very severe wetness | Nausori series | IV |

Note: Grading and Examples used here do not indicate the possibility or feasibility of draining a particular land. This will have to be considered when assessing capability.

### 6.6 Damaging flooding (wetness)

| Group symbol | Description | Example | LUC Class |
|---|---|---|---|
| A | Very occasional (once in more than 8 years) | Higher terraces, river levees | I |
| B | Occasional (once in 5-8 years) | Middle terraces, river levees | |
| C | Regular (once in 3-4 years) | Middle terraces, Back swamp | II |
| D | Frequent (once in 2 years) | Lower terraces, Back swamp | III, IV |
| E | Very Frequent (once or more annually) | Lowest terraces, gravel banks, and islands in a river | VI |

Note: This is not easy to assess. Knowledge of local residents must be sought and records of flooding in the past 20 years consulted. The grading above is based on frequency of flooding; other factors such as type and amount of material brought down by flood waters, duration of the flood, etc. must be considered when assessing its severity.

### 6.7 Depth (shallowness)

| Group symbol | Description | LUC Class |
|---|---|---|
| A | Deep (over 90cm A and B horizons | I |
| B | Slightly shallow (60-90cm) | |
| C | Moderately shallow (30-60cm) | II |
| D | Shallow (15-30cm) | III-V |
| E | Very shallow (less than 15cm) | VI-VIII |

Note: This should be used only as a rough guide. Softness and depth of the "C" horizon must be considered in the case of classes VI – VIII. For example 10– 13cm of A & B horizons overlying more than 30cm of soft "C" is best upgraded to group D. Also where shallowness is associated with stoniness then down grading should be considered.

### 6.8 Stoniness

| Group symbol | Description | LUC Class |
|---|---|---|
| A | No stones or very slightly stony | I |
| B | Slightly stony-gravels; suitable for the use of machinery | II |
| C | Moderately stony-gravels and stones; suitable for machinery after stones are collected | III |
| D | Stony-stones and boulders; unsuitable for machinery but suitable for traditional cultivation methods | IV |
| E | Very stony-boulders; unsuitable for cropping but suitable for pasture | V |
| F | Very boulder-marginal for productive vegetation | VI-VII |
| G | Extremely stony-unsuitable for productive vegetation | VIII |

Definition: Gravel = less than 2.5cm diameter
Stone = 2.5 – 20cm diameter
Boulder = more than 20cm diameter

Note: Degree of stoniness is assessed on the basis of the suitability of the land for (a) ploughing, (b) use of other machinery e.g. harvester, (c) traditional cultivation methods (d) pasture, (e) tree planting.

### 6.9 Soil fertility

| Group symbol | Description | Example | LUC Class |
|---|---|---|---|
| A | Fertile | Most alluvial soils | I |
| B | Slight infertility | Some Latosolic, Nigrescent and Colluvial soils | II |
| C | Moderate infertility | Latosolic, Nigrescent, some Humic Latosol and Gley soils | III |
| D | Infertile | Humic Latosol, Gley, Coastal sand and some Podsolic soils | IV |
| E | Very infertile | Podsolic soils and some Ferrugineous Latosol (Talasiga) | VI, VII |
| F | Extremely infertile | Ferrugineous Latosol | VIII |

Note: Also see under "Capability classes of soil types" for a more precise assessment of fertility level of soils.

### 6.10 Moisture holding capacity

| Group symbol | Description | LUC Class |
|---|---|---|
| A | Very high-deep to moderately shallow, heavy texture (clay) soils | II, III |
| B | High-deep to moderately shallow, slightly heavy texture (clayey soils) | I |
| C | Medium-deep to moderately shallow, medium texture; or shallow, heavy texture | II, III |
| D | Low-deep to moderately shallow, light texture; or shallow. Slightly heavy to medium texture. | III, VI |
| E | Very low-shallow, light texture; or very shallow, heavy to medium texture | VI-VII |
| F | Extremely low-very shallow, light texture | VII-VIII |

Definition: Heavy Texture = Heavy clay

Slightly heavy = Clayey soils not lighter than sandy clay loam.

Medium = Loam and loamy soils

Light = Sand

Note: This should be used only as a general guide. The grades are based on depth and texture of the soil. Of equal importance in assessing the capability class for each group is rainfall – frequency, intensity, and distribution throughout the year. This may raise or lower the capability in each group. Also the content of gravels and stones in the soil is just as important as this can reduce the capacity of the soil to hold moisture.

### 6.11 Salinity

| Group symbol | Description | Example | LUC Class |
|---|---|---|---|
| A | Non saline to very slightly saline | Rewa soils | 1-II |
| B | Slight salinity | Nakelo soils | III |
| C | Moderate severe salinity | Soso soils | IV, VI |
| D | Extremely saline | Togo soils | VIII |

Note: Further research is required to establish salinity classes on the basis of total soluble salts, and to correlate this with the use capability of the soil. Research is also required to establish the length of time in which the salt content could be lowered through leaching to reach an acceptable level.

Saline soils are found mostly in mangrove swamps which may be reclaimed for development. However, such land is best classified as non-arable and unsuitable for productive use (classes VII and VIII unless there is a positive plan to reclaim the area, in which case, the capability can be upgraded to a lower arable or a grazing class in the first place, then reassessed in later years as soil conditions improved.

Also see under "Mangrove swamp" for further detail.

### 6.12 Mangrove swamp (salinity/wetness)

| Group symbol | Description | LUC Class |
|---|---|---|
| A | Easy to reclaim for cropping | III |
| B | Difficult but can be reclaimed for cropping | IV |
| C | Too difficult to reclaim for cropping but can be reclaimed for marginal pasture | VI |
| D | Not feasible to develop for productive use | VIII |

Note: Unless there is a definite plan for reclaiming mangrove swamps, all should be put under classes VI and VIII in subclass W for wetness. The above grading will apply only where there is a plan for the development of an area.

### 6.13 Peat swamp (soil/wetness)

| Group symbol | Description | LUC Class |
|---|---|---|
| A | Easy to develop for cropping | III |
| B | Difficult but can be development for cropping | IV |
| C | Too difficult to reclaim for cropping but can be developed for marginal pasture | VI |
| D | Not feasible to develop for productive use. | VIII |

Note: Unlike mangrove swamps, peat land does not require the construction of such expensive structures as sea walls, etc. Accordingly its capability is assessed in the normal way regardless of

whether or not a development plan is at hand. Groups A and B have "S" limitations (peat), While C and D have "W" limitations (wetness).

### 6.14 Rainfall (climate)

| Zone symbol | Description | LUC Class |
|---|---|---|
| A | Very high-over 400mm (over 400 cm) | II-VIII |
| B | High-3000 - 4000mm (300-400 cm) | I-VIII |
| C | Moderate-2000-3000mm (200-300 cm) | I-VIII |
| D | Low-1500-2000mm (150-200 cm) | II-VIII |
| E | Very low-Less than 1500mm (less than 150 cm) | IV, VI-VIII |

Note: Rainfall affects the productivity of the land in several ways. The land may be too wet from too much rain, or droughty because of too little rain; this affects the time of planting and harvesting of crops, increases crop diseases, causes damage to the soil from the use of machinery, restricts the choice of crops, etc. Group "C" is considered the ideal range in Fiji.

For determining the rainfall, the annual average for the past 20 years should be the basis. The rainfall map by L. S. Mathews can be used as a general guide, but where available, local data must always be consulted.

### 6.15 Temperature (climate)

| Group symbol | Description | LUC Class |
|---|---|---|
| A | High-Winter Temperature<br>Rarely falls below 20°C (70°F) | I-VIII |
| B | Low-Normal winter<br>Temperature is below 20°C | II-VIII |

Note: Group B may occur only in areas like Nadarivatu and Nausori Highlands on altitudes above 2500 feet. Although cool winter temperature is considered ideal for certain crops (e.g. English vegetables) it is unsuitable for many tropical crops, therefore restricting the choice of crops. Temperature is very closely related to altitude and the two should be assessed together.

### 6.16 Altitude (climate)

| Group symbol | Description | LUC Class |
|---|---|---|
| A | Low - Less than 300 m A.S.L | I-VIII |
| B | Medium - 300-600 m | II-VIII |
| C | High - 600-1000 m | II-VIII |
| D | Very high - more than 914 m | IV-VIII |

Note: The main effect of altitude is increasing cloudiness and consequently a reduction of sunshine, thus limiting the choice of crops grown. The measurement of altitude should be based on D.O.S. 1:50,000 topographical map.

DOWNGRADING OF MAJOR CLASSES OWING TO CLIMATIC LIMITATIONS (RAINFALL TEMPERATURE AND ALTITUDE).

### 6.17 Rainfall

| | MAJOR CLASSES | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Zone | 1 | II | III | IV | V | VI | VII | VIII |
| A | II | III | IV | V + VI | V | VI | VII | VIII |
| B | 1 | II | III | IV | V | VI | VII | VIII |
| C | 1 | II | III | IV | V | VI | VII | VIII |
| D | II | III | IV | V + VI | V | VI | VII | VIII |
| E | IV | IV | IV | VI | V | VI | VII | VIII |

Class 1 land - Land in A and D zones, is downgraded to class II, and in E zone to class IV.

Class II land - Land in A and D zones is downgraded to class III, and in E zone to class IV.

Class III land - Land in A,D and E zones is downgraded to class IV.

Class IV land - Land in A,D and E zones is downgraded to class V and VI.

Class V land - Only land in E zone is downgraded to class VI.

Classes VI - VIII - No down grading

### 6.18 Altitude

| | MAJOR CLASSES | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Group | 1 | II | III | IV | V | VI | VII | VII |
| A | 1 | II | III | IV | V | VI | VII | VIII |
| B | II | II | III | IV | V | VI | VII | VIII |
| C | II | III | IV + V | IV + V | V | VI | VII | VIII |
| D | III | III | IV + V | V + VI | V | VI | VII | VIII |

Class 1 land - in groups B and C the land is downgraded to class II, and in group D it is downgraded to class III.

Class II land - This is downgraded to class III in groups C and D.

Classes III land - downgraded to classes IV and V in groups C and D.

Class IV land - In group C some land is downgraded to classes IV and V, in group D it is downgraded to classes V and VI.

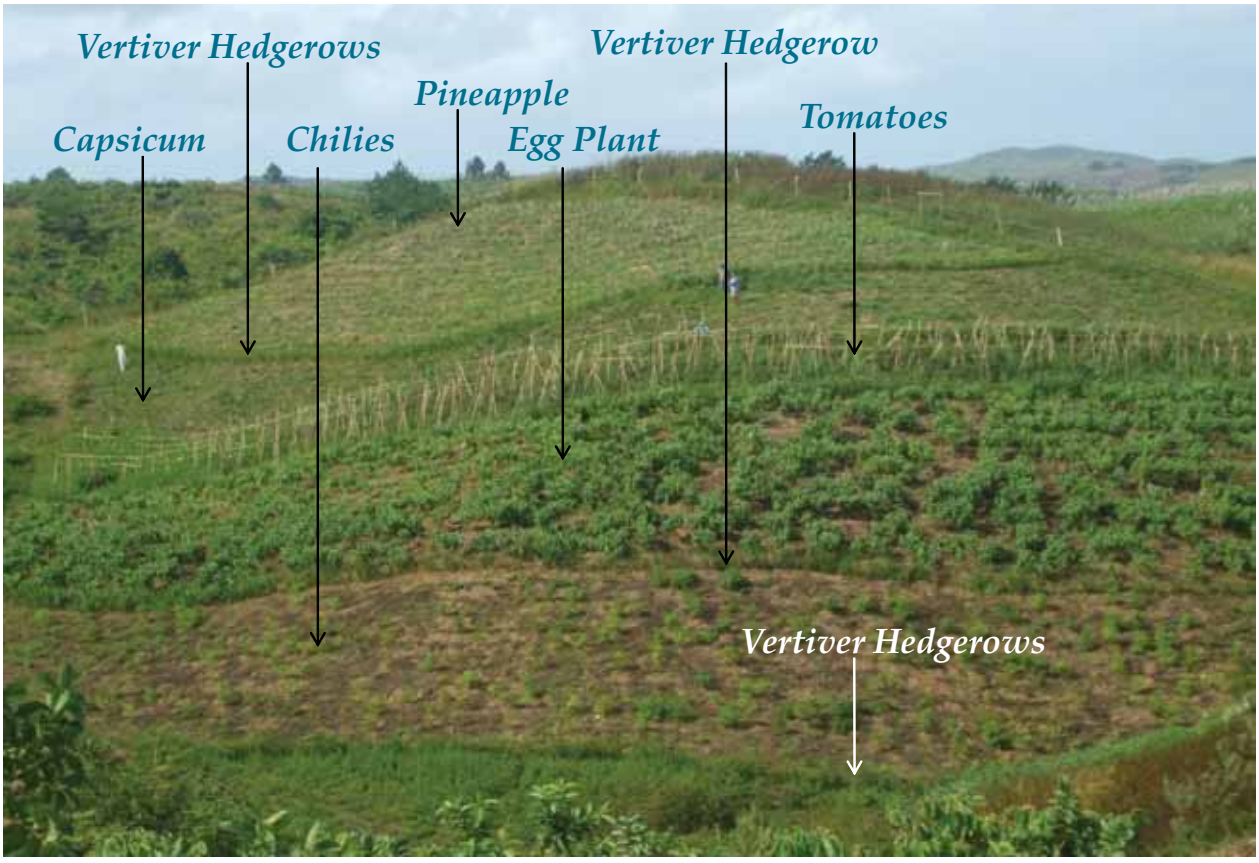
Class V - VIII - No down grading.

### 6.19 Temperature

Classes 1 – VIII all went down by one class when they occur in group B, Classes IV – VIII are not downgraded.

## Sustainable Land Management Practices 7.0

### 7.1 Alley Cropping on upland farming



## 7.2 Contour Farming


## 7.3 Control Grazing

## 7.4 Inter-cropping

## 7.5 Mulching

## 7.6 Agro-forestry

## 7.7 Nitrogen Fixation Trees



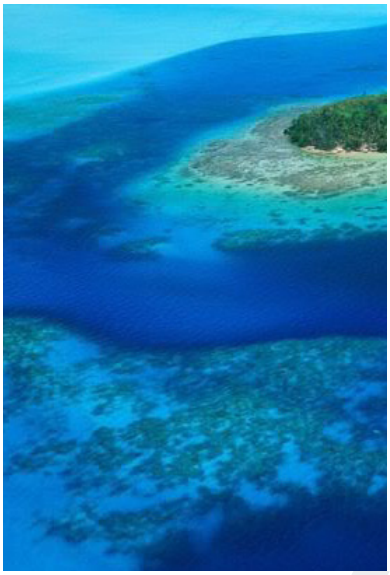


## 7.8 Land Rehabilitation in pine logged areas

## 7.9 Coastline protection with Coconuts

## 8.0 Crop Rotation

# 2014 FIJI TAX AND CUSTOMS INCENTIVES



# 2001-2014 Investment Package

## CORPORATE TAX RATE REDUCTION

| YEAR | RESIDENT COMPANIES | NON-RESIDENT COMPANIES |
|---|---|---|
| 2001 | From 35% to 34% | From 45% to 34% |
| 2002 | From 34% to 32% | From 34% to 32% |
| 2003 | No change – 32% | No change – 32% |
| 2004 | From 32% to 31% | From 32% to 31% |
| 2005 – 2008 | No Change – 31% | No Change – 31% |
| 2009 | From 31% to 29% | From 31% to 29% |
| 2010 | From 29% to 28% | From 29% to 28% |
| 2011 | 28% | 28% |
| 2012 | From 28% to 20% | From 28% to 20% |
| 2013 | 20% | 20% |
| 2014 | 20% | 20% |

- A foreign company that establishes/relocates its Headquarters to Fiji will be subject to a low corporate tax rate of 17%.
- A listed company on the South Pacific Stock Exchange (SPSE) will be subject to a low corporate tax rate of 10%.
- Income earned from trading of shares in SPSE will be exempted from Income Tax and Capital Gains Tax.

## RESIDENT TAXPAYERS: 2014 PAYE AND SRT STRUCTURE

| Chargeable Income ($) | PAYE Tax Payable ($) | Social Responsibility Tax (SRT) Payable |
|---|---|---|
| 0-16,000 | Nil | |
| 16,001 – 22,000 | 7% of excess over $16,000 | |
| 22,001– 50,000 | 420 +18% of excess over $22,000 | |
| 50,001 – 270,000 | 5,460 +20% of excess over $50,000 | |
| 270,001 - 300,000 | 49,460 + 20% of excess over $270,000 | 23% of excess over $270,000 |
| 300,001 - 350,000 | 55,460 +20% of excess over $300,000 | 6,900 + 24% of excess over $300,000 |
| 350,001 - 400,000 | 65,460 + 20% of excess over $350,000 | 18,900 + 25% of excess over $350,000 |
| 400,001 - 450,000 | 75,460 + 20% of excess over $400,000 | 31,400 + 26% of excess over $400,000 |
| 450,001 – 500,000 | 85,460 + 20% of excess over $450,000 | 44,400 + 27% of excess over $450,000 |
| 500, 001 – 1,000,000 | 95,460 + 20% of excess over $500,000 | 57,900 + 28% of excess over $500,000 |
| 1,000,001 + | 195,460 + 20% of excess over $1,000,000 | 197,900 + 29% of excess over $1,000,000 |

## NON-RESIDENT TAXPAYERS: 2014 PAYE AND SRT STRUCTURE

| Chargeable Income ($) | PAYE Tax Payable ($) | Social Responsibility Tax (SRT) Payable |
|---|---|---|
| 0-16,000 | 20% of excess of $0 | |
| 16,001 – 22,000 | 3,200 + 20% of excess over 16,000 | |
| 22,001– 50,000 | 4,400 + 20% of excess over $22,000 | |
| 50,001 – 270,000 | 10,000 + 20% of excess over $50,000 | |
| 270,001 - 300,000 | 54,000 +20% of excess over $270,000 | 23% of excess over $270,000 |
| 300,001 - 350,000 | 60,000 + 20% of excess over $300,000 | 6,900 + 24% of excess over $300,000 |
| 350,001 - 400,000 | 70,000 + 20% of excess over $350,000 | 18,900 + 25% of excess over $350,000 |
| 400,001 - 450,000 | 80,000 + 20% of excess over $400,000 | 31,400 + 26% of excess over $400,000 |
| 450,001 – 500,000 | 90,000 + 20% of excess over $450,000 | 44,400 + 27% of excess over $450,000 |
| 500, 001 – 1,000,000 | 100,000 + 20% of excess over $500,000 | 57,900 + 28% of excess over $500,000 |
| 1,000,001 + | 200,000 + 20% of excess over $1,000,000 | 197,900 + 29% of excess over $1,000,000 |

# 2001-2014 Investment Package

## INVESTMENT ALLOWANCE

- Investment allowance (excluding cost of labor) of 40% for extension and renovation expenses with a minimum qualifying capital expenditure of $50,000. This is only available to existing businesses in Vanua Levu.

## LOSS CARRIED FORWARD

- Loss carried forward can be claimed up to 4 years. Loss carried forward by a company is allowed if that entity satisfies the continuity of ownership test or the same business test.

## ACCELERATED DEPRECIATION

- Accelerated depreciation for building erected before 2001 has been extended to 2014. 20% depreciation for building used for agricultural, commercial or industrial purpose can be written off within any 5 of 8 years.
- 100% write off will be available in the year the expenditure was incurred on water storage facilities and renewable energy plant and machineries.
- This will also be available to new plants and machineries used for manufacturing purposes.

## DUTY CONCESSIONS

**PRODUCTION INPUTS**

- All goods used as raw materials in the manufacture of approved goods not available locally will attract 3% fiscal duty + 15% VAT, and all raw material used for manufacturing by companies outside of Viti Levu will attract 0% fiscal duty + 15% VAT.

**CAPITAL ITEMS**

- Duty rates on capital items (which refer to machinery used for converting / processing raw materials) will attract 0% fiscal duty + 15% VAT.

**DUTY SUSPENSION SCHEME**

- Enables exporters to have access to inputs without having to pay for duties upfront.
- Imported goods are conditionally relieved from payment of fiscal duty and VAT on the basis that such goods will be substantially transformed through manufacturing or processing and subsequent exportation.
- The Scheme would entitle exporters to import duty free an amount equal to the proportion of approved imported inputs required to produce exports. This is called entitled Proportion (EP).
- Administered by the Fiji Export Council, which is a private sector led organization.
- Zero fiscal duty on New Machinery and Equipment that are directly related to the production process.

## EXPORT INCOME DEDUCTION

- "Export income" means net profits derived by a taxpayer from the business of exporting goods and services but excludes re-exports. Deduction shown below.

| Year of assessment | Percentage of export income to be deducted |
|---|---|
| 2011 | 50% |
| 2012 | 40% |
| 2013 | 40% |
| 2014 | 40% |

- Export income deduction will only be allowed if the Commissioner of Inland Revenue is satisfied that the export earnings will be remitted to Fiji.

# Hotel Industry Incentives

## STANDARD ALLOWANCE

- Investment allowance (in addition to ordinary depreciation) of 55% of total capital expenditure is allowed as a deduction provided there is no shift of tax revenue to other countries.
- Applicable to building of new hotel including renovations or refurbishments or extensions of existing hotel and International Retiree Facilities.
- Investment Allowance can only be written-off against the income of the hotel business or income from the hotel premises.

# Hotel Industry Incentives

## STANDARD ALLOWANCE (CONT'D)

- Losses carried forward extended to 8 years.
- Recipients of the provisional approval for Standard Allowance to commence implementation of project within one year.
- Investors would only need to provide a sketch plan to obtain provisional approval for the investment allowance, and not necessarily a certified approved.

## NEW SHORT LIFE INVESTMENT PACKAGE

- 10 year tax holiday for capital investments not less than $7 million.
- Import duty exemption on all capital goods (including capital equipment, plant & machinery) not available in Fiji but this does not include furniture or motor vehicles that are used in carrying out the investment.
- Short Life Investment Package (SLIP) Incentives is also available for retirement facilities and hospital resorts.
- Recipients of the provisional approval for Standard Allowance to commence implementation of project within one year.
- Investors would only need to provide a sketch plan to obtain provisional approval for the investment allowance, and not necessarily a certified approved.

## BACKPACKER OPERATIONS

- Income tax exemptions for locally owned backpacker operators with annual sales turnover of $1m or less.
- Duty exemption on the importation of raw materials and equipment used for the establishment of a backpacker hotel. (This incentive will only be available to backpacker businesses who are granted the income tax holiday).

# Audio Visual Incentives

## INCOME TAX DEDUCTIONS

- 150% deduction for capital expenditure on an F1 audio-visual production.
- 125% deduction for capital expenditure on an F2 audio-visual production.

**Levels of Expenditure in Fiji for an audio-visual production for F1 and F2 status should not be less than:**

- 40% for a large format film, a feature film or broadcast television programmes;
- 50% for a direct to video programme or video disk programme; and
- 55% for an audio recording.

## INCOME TAX EXEMPTION

- Net income from an F1 production is exempt until taxpayer has received a 60% return on capital expended. Thereafter, net income will be fully taxed at the marginal rate.
- Net income from an F2 production is exempt until taxpayer has received a 50% return on capital expended. Thereafter, net income will be fully taxed at the marginal rate.

# Audio Visual Incentives

## STUDIO CITY ZONE CONCESSIONS

- Any sole proprietor, partnership or company that carries on a production activity (the production of, distribution of or supply of services to audio-visual productions) may qualify for an operating licence in the Studio City Zone and be entitled to an exemption from tax on the income from the production activity carried on in the Zone.
- Tax free status for "permanent residents" of the Studio City Zone on income derived as earnings from audio-visual productions.

**For residence in the Zone to be approved, in the case of citizens, the individual must be:**

- resident in the Zone for at least 183 days;
- have pre-tax audio visual earnings in excess of $100,000;
- have fixed assets in the Zone in excess of $250,000; and
- maintain a primary place of residence in the Studio City Zone.

**For residence in the Zone to be approved, in the case of non-citizens (or a citizen who derives a minimum of 80% of audio visual earnings from outside Fiji), the individual must be: -**

- resident in the Zone for at least 60 days;
- have pre-tax audio visual earnings in excess of $100,000;
- have fixed assets in the Zone in excess of $250,000; and
- maintain a permanent place of residence in the Studio City Zone.

## FILM TAX REBATE

**Summary Part IV, 6th Schedule – Income Tax Act**

| | Fiji Film Tax Rebate Bill |
|---|---|
| Rebate Amount | 47% tax rebate or credit on production costs spent in Fiji: paragraph 68(1) |
| Eligibility | Films and television productions, as per existing Sixth Schedule: paragraph 69 |
| Minimum Spend in country | Minimum spend in Fiji F$250,000 for feature films and broadcast television; and $50,000 for production intended as an advertising program or commercial in at least one significant international market : paragraph 69(e) |
| Maximum Rebate | F$11.75 million, so even if more than $25 million spent in Fiji the maximum rebate is still F$11.75 million: paragraph 68(2). |
| Exclusions | Where a producer has chosen to access the film tax rebate, the producer will not be able to obtain any other tax concessions under Parts 3 of Sixth Schedule: paragraph 67(2). |

**Additional Incentives (Allowable Expenditures):**

- Allowable expenditure incurred for services rendered by the producers (producer's fees) – provided that such expenditure shall not exceed 10% of the total Fiji Expenditure. Producers are not restricted to remain in Fiji throughout the production of the film.
- 75% of the expenditure incurred to purchase costumes, make-up and set design properties not available in Fiji that will be used in relation to the film production in Fiji provided that any such costumes, make-up and set design properties shall be left in Fiji at the end of the production.
- Expenditure incurred to purchase the writer's story and rights for the production of the film provided that the producer submits the following documentary evidence:
  - o Notarized legal contract with the writer which is registered in Fiji with the Registrar of Deeds upon payment of the appropriate stamp duty;
  - o Evidence of payment made directly into the writer's bank account from the Fiji bank account; and
  - o Receipt of acknowledgement of payment received.
- Approved post-production expenditure on the film paid from a Fiji bank account to the extent that it is incurred or reasonably attributable to approved post-production services in relation to the completing of the film made in Fiji. The maximum payable in rebate shall be granted upond the production of documentary evidence of the expenditure. Rebate is around 2%-2.5% of production budget.
- Expenditures incurred on hiring of cameras and filming equipment from outside Fiji, where such cameras and filming equipment are not available in Fiji.

**Additional Requirements:**

- Companies should engage Audio Visual Agents
- Fiji as a location needs to be accredited and acknowledged in the film's credits and other accreditation as stipulated by Film Fiji in their approval letter.

# Agriculture Incentives

## COMMERCIAL AGRICULTURE AND AGRO-PROCESSING

- The Importation of all agricultural items will be subject to zero Duty.

## NEW BUSINESSES FROM 2009 ONWARDS

- The income of any new activity in commercial agricultural farming and agro-processing approved and established from 1 January 2010 to 31 December 2014 shall be exempt from tax for 10 consecutive fiscal years with a capital investment of $2,000,000 or more.

## BIO – FUEL PRODUCTION

- 10 year tax holiday is available to a taxpayer undertaking a new activity in processing agricultural commodities into bio-fuels as approved by the Commissioner from 1 January 2009 to 31 December 2014. To qualify, the taxpayer must have:-
  - Minimum level of investment of $1,000,000; and
  - Employ 20 local employees or more for every income year.
- Duty free importation of plant, machinery and equipment for initial establishment of the factory.
- Duty free importation of chemical required for bio-fuel production.

# Small And Micro Enterprises

## SMALL AND MICRO ENTERPRISES

Income tax exemption to be applicable to selected sectors with maximum turnover threshold of $500,000. The sectors include:

- Agriculture and Fishing (Sugarcane Farmers; Coconuts; Rice; Ginger; Yaqona; Fishing; Raising Livestock; Vegetable; dalo, cassava and other root crops production; farming and Bee keeping).
- Tourism (Sea Cruise and River tour Operators).
- Community and Social Services (Amusement, recreation services; traditional handicraft producers (not "middleman" or agents).
- Supportive projects to tourism industry (flora, fauna and other natural characteristics of Fiji; and history, traditions, cultures and ways of life of its peoples).

# Tax Free Region (TFR) Incentives

## TFR INCENTIVES

**Who will qualify for this incentive?**

This incentive is available to a newly incorporated entity engaged in a new trade, business or manufacture established in the following areas:-

- Vanua Levu – included Taveuni, Rabi, Kioa and other islands generally included for government's administrative purpose as being in the Northern Division.
- Rotuma
- Kadavu
- Levuka
- Lomaiviti
- Lau; and
- East of Viti Levu (Korovou-Tavua region)

- Any company may apply to the Minister for Finance in a prescribed form (Form 6) for an operating license.

**Criteria for Grant of License**

- The company is a newly incorporated entity engaged in a new trade, business or manufacture.
- The minimum initial level of investment should be $250,000 from 1 January 2010.

**Tax Exemptions Available**

(i) The income of any new activity approved and established between 1 January 2010 to 31 December 2018 shall be exempt from tax as follows:
  - capital investment from $250,000 to $1,000,000, for a period 5 consecutive fiscal years; or
  - capital investment from $1,000,000 to $2,000,000, for a period of 7 consecutive fiscal years; or
  - capital investment above $2,000,000 for a period of 13 consecutive fiscal years.

**Duty Exemption**

Import duty exemption on the importation of raw materials, machinery and equipment (including parts and materials) insofar as they are required for the establishment of the business in the Tax Free Region.

**Other benefits under the TFR**

- Additional 5 years of income tax exemption is available to any company granted a license and having indigenous Fijian landowner equity of at least 25 percent.
- Additional 7 years of income tax exemption is available to any hotel developer granted a license and having indigenous Fijian landowner equity of at least 25 percent.

# Information Communication Technology (ICT) Incentives

## ICT INCENTIVES

The income of any new operator who is granted a license from 1 January 2009 to be exempt from tax for a period of 13 years

- Any new operator may apply and pay a license fee of $1,000 per annum to the Commissioner of Inland Revenue. The Tax exemption is granted from the date of the initial license.
- Income tax exemption is available to investors under the following criteria:-
  - Business employs 50 employees or more for any 6 months within the income year; and
  - 60 percent of its total services is exported.
- Duty free importation of computer, computer parts & accessories, plant, equipment & fittings, and specilised furniture for initial establishment and during its ongoing operations to approved ICT/BOP Business operators from 1 January 2009.

# Manufacturers Incentives

## FOOD PROCESSING & FORESTRY

- 100% of the amount of investment as a deduction for investing in food processing as well as forestry. Re-investment will also be allowed for expansion purposes. In order to qualify, the investor should utilize 50% of local produce in its production process.

## RENEWABLE ENERGY PROJECTS AND POWER CO-GENERATION

- 5 year tax holiday is available to a taxpayer undertaking a new activity in renewable energy projects and power cogeneration as approved by the Commissioner.
- Duty free importation of renewable energy goods is also available.

# Other Incentives

## SHIPPING COMPANIES

**Maritime Shipping**

- 100% of the amount of investment as a deduction for investing in food processing as well as forestry. Re-investment will also be allowed for expansion purposes. In order to qualify, the investor should utilize 50% of local produce in its production process.

## UNIT TRUST COMPANIES

**Withholding Tax and Capital Gains Tax Waiver**

- Withholding taxes and capital gains taxes on interest income distribution to investors of the Unit Trusts will be waived.

## FIJI MY SECOND HOME PROGRAMME

- This Programme is open to citizens of other countries recognized by Fiji in the "Fiji My Second Home Programme" as administered by the Reserve Bank of Fiji.
- Interest income is exempt from tax under the following criteria:-
  - o Age below 50 years old:
    - Minimum deposit of $150,000 and maintain the deposit in Fiji for a minimum of two years.
  - o Age 50 years and above::
    - Minimum deposit of $100,000 and maintain the deposit in Fiji for a minimum of two years.
- To qualify the applicant must maintain a minimum balance of $50,000 from the third year onwards and throughout the entire stay in Fiji.

## FOREIGN CURRENCY ACCOUNT SCHEME

- Interest income is exempt from tax which accrues to or in favor of a non-resident including former Fiji residents who hold funds in Fiji commercial bank accounts under the following criteria:-
  - For foreign currency accounts, interest income for deposit above the equivalent of FJD$150,000;
  - For Fiji Dollar accounts, any amount of interest income.

# Other Incentives

## OTHER INCENTIVES

- **Employment Taxation Scheme** – 150% of the salary and wages paid by an employer within 1 January 1997 and 31 December 2018 are tax deductible. The deduction is restricted to salary and wages paid in respect of 12-month period commencing from the date of the appointment of the employee provided he or she has not previously been in full-time paid employment. This is extended to trainees and apprentices.

- **Donation of new Computers, Laptops & Tablets** - 150% and 200% tax deductions for donation of computers to schools registered with the Ministry of Education, will be available with the following features:
  - 200% tax deduction relates to donation to schools in rural areas.
  - 150% tax deduction relates to donation to schools in urban areas
  - Donations to be between $10,000 to $100,000.

- **Voluntary Contribution for Disaster Relief** - 150% tax deduction for voluntary contribution of cash donation by businesses towards a Disaster Relief Fund. The threshold will range from a minimum contribution of $10,000 to a maximum contribution of $100,000.

- **Sports Sponsorship** - 150% tax deduction for sports sponsorship with a minimum cash sponsorship of $50,000.

- **Sponsorship of hiring of international Coaches** – 150% tax deduction for sponsorship between $100,000 and $200,000 towards the hiring of international sporting coaches.

- **Cash Contribution towards Housing Projects** - 150% tax deduction for cash contributions up to $50,000 towards any Government sanctioned housing project for squatters and informal settlements.

- **Incentives for Senior Citizens** - All Senior citizens (over 55 years) and Pensioners will be exempted from paying resident interest withholding tax on interest income of up to $16,000 from bank deposits, provided this is their only source of income.

# OTHER CUSTOMS CONCESSIONS

## Newly introduced concessions

| Items | Descriptions | Fiscal Duty | VAT (%) |
|---|---|---|---|
| Food Supplements | Reduce fiscal duty on food supplements from 32% to 0%<br>Food supplements include essential vitamins and fortifications which are predominantly used by pregnant mothers, senior citizens and chronically ill patients. | 0% | 15% |
| Baby feeding bottles | Reduce fiscal duty on baby feeding bottles from 32% to 0%.<br>To reduce importation of cheap low quality baby bottles which may cause health risks. | 0% | 15% |
| Shipping Incentives | Duty on the importation of all spare parts for maritime vessels is reduced to 0%. | 0% | 15% |
| Promote domestic Fishing industry | Exemption of Bunker fee of 2 cents/litre for local fishing vessels;<br>Duty concession on specialized fishing item/equipment which are currently not covered under the existing concession for the fishing industry. | - | - |

# Other Customs Concessions

## NEWLY INTRODUCED CONCESSIONS (cont'd)

| Items | Descriptions | Fiscal Duty | VAT (%) |
|---|---|---|---|
| Agriculture | Duty on the importation of all agricultural items will be reduced to 0%. | 0% | 15% |
| Adult sanitary diapers | Duty on the Importation of all sanitary diapers will be reduced to 0% | 0% | 15% |
| Pre-fabricated homes (kit homes) | Duty on prefabricated homes will be reduced from 32% to 3% and duty on prefabricated concrete products and iron panels for commercial use will be reduced from 32% to 5%. | Prefab homes (3%)<br><br>Prefab concrete & Iron panels (5%) | 15% |
| Duty concession for returning residents | Duty concession under code 220 (Free Fiscal, Free import excise, Free VAT) on importation of house hold effects and vehicles by returning residents. This concession is subject to certain conditions under Code 220. | 0% | Free |

## OTHER EXISTING CONCESSIONS

| Industry | Items | Fiscal Duty | VAT (%) |
|---|---|---|---|
| Agriculture & Dairy | Specialised agriculture, livestock and dairy machineries, equipment and agricultural inputs excluding those that attract duty rates of free Fiscal and free Import Excise in the Tariff. The importation under concession is subject to the condition that a letter of approval is issued by the Ministry of Agriculture in relation to goods under concession. | Free | 15% |
| Bus Operators | Bus operators holding Road Service Licence operating under schedule trips approved by Land Transport Authority.<br>Refund of duty on gas oil (diesel) having sulphur content not exceeding 500ppm purchased ex-duty paid stock. | 2 cents per litre refund | |
| Fisheries & Forestry | Specialised machineries directly used for fisheries and forestry purposes. The importation under concession is subject to the condition that a letter of approval is issued by Department of Fisheries & Department of Forests in relation to goods under concession. | Free | 15% |
| Maritime Safety Authority of Fiji (MSAF) | Life jackets procured from local manufacturers operating under TFF or DSS.<br>The imported raw materials incorporated in the manufacture of life jackets. | Free | 15% |
| Sports Supplement | Protein shakes and sporting tablets/capsules that will enhance athletic performance by supplying nutrients to the body which are lost in the process of strenuous training and fitness programs. This concession does not extend to the products Powerade, Gadtorade, Red Bull, V-Drink and Mother, etc. | Free | 15% |

## DISCLAIMER

These incentives are available as at 1st January 2014. For their availability and application, please contact FRCA Policy and Research Unit:
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# FIJI

# FARM MANAGEMENT MANUAL 2014


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